

November 13, 1961

Aviation Week

and Space Technology

75 Cents

A McGraw-Hill Publication

SPECIAL REPORT:

**Swiss Air Force
Close-Support,
Intercept Roles**

Hiller Ten99 Helicopter





In your case, or in ours

The new 1508 Vindicator should be your next outillagegraph

The Model 1508 Honeywell Vindicator has been specifically designed to quickly and easily slide into your data reduction system. There it will serve as a direct information read-out device, recording IAC to 3600 cycles from one to 24 channels, as it may serve as a monitor or other component in your system, or it may do both jobs, a real time-out if you wish.

You have no "data reduction system," as such? Then consider the true, refinement 1508 as a bench instrument. Its push-button controls, selection of 12 chart speeds (meters, if desired), 8"

paper width, and direct writing speeds exceeding 50,000 in. sec. will help to make it one of your most useful tools. Its rig, and how ensures constant alignment of applied components regardless of external stress on the instrument.

In your case — — the 1508 needs only 7" of rack height. In ours — — it arrives ready to go to work as a convenient, portable instrument. In any case, be sure to see the new 1508 Vindicator before you order your next outillagegraph. Write for Catalog HC-1508 to Minneapolis-Honeywell, Bedford Division, 3200 East Evans, Denver 22, Colorado.

Honeywell

 *First in Control*

CAPABILITY is spelled M-a-c-h 3 s-y-s-t-e-m-s



400° F
Mach 3 starter motor/pump



3000° F
Mach 3 servo valve



600° F
Titanium nuclear reactor



600° F
Mach 3 servo valve



400° F
Diesel pump for EIS

Flight speeds of Mach 3 and higher introduce new problems in auxiliary power system design and operation. A well-defined program* in existence for more than six years at Vickers has been devoted to high temperatures—in the 150° to 1400° F range—and their effects on materials, fluids and electronics.

Exotic Fluids—Systems have been designed and tested for a broad range of hard-to-handle fluids including deaerated kerosene at 330° F., synthetic base fluids (MLO 5200) at 450° F., super refined mineral oil (MLO 1314) at 700° F., mixed esters of bis(phosphoryl) ether at 700° F., liquid metal (NaK 77) at temperatures to 1400° F.

Hot-Temp Components—Specialized high temperature applications require parallel activity in valve systems and related components (see examples at left). A special development program includes servo valves for the -60° to 500° F. range with extremely low thermal drift.

Compatible Materials—Related studies evaluate manufacturing and appliance problems on materials including tungsten and titanium carbides, titanium and high alloy stainless steels. All have optimum application in providing stress strength needed at maximum additional weight in actuators, valves, pistons and sub-system packages.

Specific facts about Vickers accumulated experience, facilities and "hardware" delivered are available. Ask for Bulletin A-686.

AERO HYDRAULIC DIVISION
VICKERS INCORPORATED
DETROIT 22, MICHIGAN
Torrance, California

Member of
SPERRY RAND
CORPORATION

***PROGRAMMED POWER IN:
ENERGY CONVERSION
FLUID TRANSPORT**



At completion of high temperature test, titanium reactor prototype pump (see item of system being developed for Mach 3 flight). Systems are also increasingly used and concerned with test, processing special test facilities to include operating conditions.

Minimum safety holding located at base distance from main research facilities for test cells used exclusively in high temperature tests.



Hot hardware test is used to predict behavior of special alloys during extended operations at elevated temperatures.

New Kidde 5000 psi pneumatic system features mobility, precision regulation!



From the laboratories of Walter Kidde & Company, Inc., comes this mobile pneumatic system which delivers 4 cfm of clean, dry air at pressures up to 5000 psi. Completely portable and easy to maneuver, the system features two highly accurate regulators: one for pressures ranging of 0-2000 psi; the other for pressures up to 5000 psi. All controls and gauges have been aligned at the optimum level for accuracy and ease of handling. Light in weight, the system measures 32" by 48" by 32", and is available powered with either electric or hydraulic motors or gasoline engine.

Used for aircraft and missile ground-support equipment and for laboratory applications, systems of this type can supply high and low-pressure air in ambient temperatures varying from -40 degrees to +120 degrees F. For more information, write Kidde today.



Kidde Aero-Space Division

Walter Kidde & Company, Inc., 1118 Main St., Belleville 6, New Jersey

Walter Kidde & Company, Inc. is a Division of Kidde Corporation, 200 N. 10th St., New York 100, New York. Kidde Corporation is a subsidiary of Kidde Corporation, 200 N. 10th St., New York 100, New York.

AEROSPACE CALENDAR

(Continued from page 5)

- January: *Stations Park Hotel, Washington, D. C.*
- Dec. 18-19: *Wright Brothers Lecture, National Air Society, Washington, D. C.*
- Jan. 8-12-1962: *Aerospace Engineering Congress and Exposition, Society of Automotive Engineers, Cobo Hall, Detroit*
- Jan. 9-11-English National Symposium on Reliability and Quality Control, Statler Hilton Hotel, Washington, D. C.
- Jan. 14: *Symposium on Optical Character Recognition, Department of the Interior, Auditorium, Washington, D. C.*
- Jan. 14-15: *Symposium on Information Systems Research, Office of Naval Research and Research Information Center, National Bureau of Standards*
- Jan. 22-24: *Annual Meeting, Helicopter Association of America, Marriott Motor Hotel, Dallas, Tex.*
- Jan. 22-24-1962: *Annual Meeting, Institute of the Aerospace Sciences, Hotel Astor, New York, N. Y. (Hawaii Night Dinner, Jan. 23)*
- Jan. 23-25: *Third Annual Solid Propellant Rocket Conference, American Rocket Society, Burke University, Wake, Tex.*
- Jan. 24-26: *Second Symposium on Thermophysical Properties, Princeton, N. J. Sponsored by Thermochemical Properties Division, American Society of Mechanical Engineers*
- Feb. 6-7: *Symposium on Reliability Techniques for Computing Systems, Department of the Interior, Auditorium, Washington, D. C. Sponsored by Information Systems Research Office of Naval Research*
- Feb. 7-9: *Third Winter Conference on Military Electronics, 1962, Ambassador Hotel, Los Angeles*
- Feb. 14-16: *International Solid State Circuits Conference, Institute of Radio Engineers, Sheraton Hotel and University of Pennsylvania, Philadelphia, Pa.*
- Feb. 18-21: *Range Reliability and Testing of Aerospace Vehicles, Institute of the Aerospace Sciences, San Francisco*
- Feb. 22: *Mar. 1-Third Annual Symposium on Nondestructive Testing of Aircraft and Missile Components (sponsored by Control Tech.) San Antonio, Tex. Sponsored by Texas Science Society for Nondestructive Testing, Southwest Research Institute*
- Feb. 27-Mar. 1: *Symposium on the Application of Statistical Theory in Space Technology, Palo Alto, Calif. Sponsored by Lockheed Aircraft Corp., Air Force Office of Scientific Research*
- Mar. 4-5: *English Solid State and Sensor Detector Circuits Symposium, IRE, Sheraton Hotel, Washington, D. C.*
- Mar. 14-15: *Seventh Annual Air Traffic Control and Production Show, American Society of Mechanical Engineers, Sheraton Hilton Hotel, Houston, Tex.*
- Mar. 8-14: *Institute of the Aerospace Sciences Flight Propulsion Meeting, Hotel Interlaken, Cleveland, Ohio*
- Mar. 14-16: *Electrical Propulsion Conference, American Rocket Society, U. S. Naval Postgraduate School, Monterey, Calif.*
- Mar. 26-28: *International Conference, IRE, Coliseum and Waldorf Astoria, New York*

INPUT FROM OUT THERE

Man's comprehension of the cosmos grows with his ability to assess and control the space environment. This is the task of astronautics—the discipline that integrates electronics, optics, mechanics, and the information sciences into unified systems.

Aerjet General's Astronics Division, manufacturer of the infrared subsystem of the MIDAS satellite, offers complete capability in research, development, and production of advanced astronics systems for—

- Guidance and Control
- Target Detection and Identification
- Searching and Tracking
- Electronic Support
- Information Sciences
- Radar and Spectral Analysis

ASTRONOMICS DIVISION

Aerjet-General
CORPORATION
Azusa, California

A subsidiary of the General Electric Company

Engineers, scientists—investigate outstanding opportunities at Aerjet



KEARFOTT is producing
precision floated gyros for the
Skybolt missile



*Engineer Kearfott offers
challenging opportunities in advanced component and system development.*

KEARFOTT DIVISION
Little Falls, New Jersey



GENERAL PRECISION, INC.
Other Divisions: GPM, Lubrication, Lock

VIBRATION RESISTANT
MOISTURE RESISTANT
QUICK DISCONNECT

BANTAM
COMPLETELY INTERCHANGEABLE

miniature solder connectors certified to MIL-C-26482 (ASG)

Up to 32 contacts in an area the size of a . . .
providing for 61 contacts in an area
slightly larger, the Bantam line is avail-
able in a wide variety of asset con-
figurations and shell sizes. Extra heavy gold
plating, 75 micro inches — far exceeding
current specifications provides extra protec-
tion against corrosion. The Bantam contacts also provide



hard gold mating against soft gold adding durability and non-
tendering galling. An exclusive wire seal mounted well and all
repaired wires and in addition type SE, NW, W, 1-16578. Elec-
trically, mechanically, BANTAM connectors have proven some-
times dependable. Copper alloy closed entry sockets, extra
heavily gold plated over silver . . . moisture proof resistant in-
serts . . . minimum plated shells of impact extruded alu-
minum . . . heavy spring tension for perfect interface sealing.

For further information write OMATON DIVISION

BURNDY

NORWALK, CONNECT. BCD-BURNDY Ltd. Prescott, Lancs., England in Europe, Africa, Belgium TORONTO, CANADA



Miniaturized cavity-type filter packs 4.2 square inches of filtering area into 1" x 1/2" element

Parvulator develops flask-vial size element to protect hydraulic control circuits on Army's Hawk missile mobile launcher.

How small can you make an element that must filter 2 gpm hydraulic oil at 3000 psi at any temperature within a 305° range? Parvulator's new miniature cavity-type hydraulic filter is the best answer to date. Here's why:

4.2 square inches of cross-hatched stainless steel wire cloth are packed into this miniature filter. This element, which weighs 0.15 ounces, filters two gallons per minute of hydraulic oil, at temperatures ranging from -60° to 400° F. The element will withstand 3000 psi differential pressure without clogging.

The element is made up of a mesh of flange of stainless steel wire, woven into wire cloth and encased in a rigid aluminum case. This element will remove 95% of all particles whose free smallest dimension are larger than 10 microns, and 100% of all particles measuring 25 microns or more.

The picture at the top of this page shows you the complete filter assembly, ready for installation in the hydraulic control system. The overall length of the unit is 2 1/2"; maximum overall diameter is 1". Total weight is slightly over 2 ounces. Designed to be easy to install, the filter is attached simply by screwing it into the hydraulic system as the filter element interrupts oil flow. The element can be removed, cleaned and replaced without special tools.

The picture at right shows the mobile launching platform for the Hawk Missile. The compactness and mobility of the



launcher, and the possibility that it would be subjected to severe jolting, make it necessary to specify as small a filter as possible, and one that could be integrated with the rest of the system for maximum simplicity and durability.

The Parvulator engineers who developed this new miniature cavity-type filter are available now to design a filter to meet your specifications. Simply contact Parvulator Products, Inc., Department 3006, Rahway, New Jersey.

Filters for Every Known Fluid

PURVULATOR

PRODUCTS, INC.

RAHWAY, NEW JERSEY AND TROBROOK, BOSTON, MASSACHUSETTS



RYAN— ONLY VOLUME PRODUCER OF DOPPLER NAVIGATORS FOR HELICOPTERS

Most experienced in the field of Doppler navigation, Ryan Electronics, over the last fourteen years has pioneered the major advances in the application of CW Doppler to airborne navigation.

In production and in use for years, RYANAV sets for helicopters, V/STOL, and fixed wing aircraft have been proven under the most difficult operating conditions throughout the world.

Small, lightweight, reliable, with the highest performance

capabilities, RYANAV sets are the most advanced and most versatile yet devised. Completely self-contained, RYANAV Doppler measures air direction velocity over all terrain under all-weather conditions. It is compatible with navigational aids, autopilot, and automatic control devices requiring accurate speed setting.

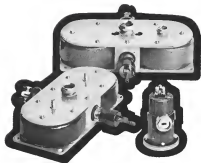
RYANAV sets are available now. Ground Speeds minus 50 to 2,000 knots. Vertical Velocity to 80,000 feet per minute. And Altitudes to 70,000 feet.

The U. S. Government, and other nations of the Free World rely on Ryan as the producer of Doppler navigators for helicopters. Ryan Electronics—Ryan Aeronautical Company, San Diego, California.

RYANAV Doppler Navigators now in full production for helicopters (over 500 already in use): AN/APN-97A Helicopter Ground Velocity Indicator; AN/APN-130 Helicopter Heading and Ground Velocity Indicator.

RYAN
ELECTRONICS

Ryan Electronics offers challenging opportunities to engineers



Ku-BAND TO 80 KMC

LONG-LIFE MILLIMETER WAVE KLYSTRON TUBES FROM LITTON

For applications in the 10-80 KMc range, the Litton Electron Tube Division now offers the Elliott-Litton line of quality engineered millimeter wave tubes.

The floating drift tube design used for most Elliott-Litton klystron oscillators produces the effect of a single cavity tube with the working efficiency of a two-cavity klystron. Additional advantages of this design are freedom from hysteresis, stability of operation, and exceptionally low thermal drift. Reflex klystrons are available in the 32 and 8 millimeter regions.

Applications include radar and communication systems, signal sources for microwave spectroscopy, gaseous plasma experiments, high stability pumps for masers or parametric amplifiers, and local oscillators.

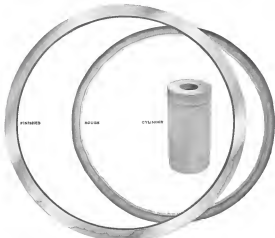
Contact us at San Carlos, California, for more information on Elliott-Litton tube types or as any of an extensive array of Litton microwave and display tubes and accessories.

ILLUSTRATION OF TYPICAL MILLIMETER WAVE KLYSTRON TUBES

Tube No.	Frequency Band	Minimum Input Power	Maximum Power Output	Operating
	KW-1	KW-2	KW-3	KW-4
1.1000	80-85	1000	0.1000	0.0010
1.1005	80-85	1000	0.1000	0.0010
1.1010	80-85	1000	0.1000 average	1.0010
1.1015	80-85	1000	0.100	0.0010
1.1020	80-85	1000	0.100 average	0.0010
1.1025	80-85	1000	0.100	1.0010
1.1030	80-85	1000	0.100	1.0010
1.1035	80-85	1000	0.100	1.0010
1.1040	80-85	1000	0.100	0.0010
1.1045	80-85	1000	0.100	0.0010
1.1050	80-85	1000	0.100	0.0010
1.1055	80-85	1000	0.100	0.0010
1.1060	80-85	1000	0.100	0.0010
1.1065	80-85	1000	0.100	0.0010
1.1070	80-85	1000	0.100	0.0010
1.1075	80-85	1000	0.100	0.0010
1.1080	80-85	1000	0.100	0.0010
1.1085	80-85	1000	0.100	0.0010
1.1090	80-85	1000	0.100	0.0010
1.1095	80-85	1000	0.100	0.0010
1.1100	80-85	1000	0.100	0.0010
1.1105	80-85	1000	0.100	0.0010
1.1110	80-85	1000	0.100	0.0010
1.1115	80-85	1000	0.100	0.0010
1.1120	80-85	1000	0.100	0.0010
1.1125	80-85	1000	0.100	0.0010
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1.2085	80-85	1000	0.100	0.0010
1.2090	80-85	1000	0.100	0.0010
1.2095	80-85	1000	0.100	0.0010
1.2100	80-85	1000	0.100	0.0010
1.2105	80-85	1000	0.100	0.0010
1.2110	80-85	1000	0.100	0.0010
1.2115	80-85	1000		

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PROBLEMS OF WELDED RINGS THIS CM-R 41 RING IS FORGED FROM A CYLINDRICAL CASTING INSTEAD OF ROLLED FROM BAR STOCK AND WELDED. THIS INHERENT, WELD-FREE CM-R 41 RING IS THE RESULT OF A CASTING PROCESS DEVELOPED BY CM USING A THIN CROSS SECTION RATHER THAN THE CONVENTIONAL, THICK INSET, BECAUSE THE CROSS-SECTION IS THINNER, IT COOLS FASTER. THIS FAST COOLING PREVENTS SEGREGATION OF ELEMENTS—ELIMINATES STRESSING—GRAIN SIZE IS MORE UNIFORM. YES, AND THE RING HAS GREATER HOMOGENEITY THAN RINGS PRODUCED BY OTHER METHODS.



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Science Series Defense at Westinghouse

The new underwater acoustic test laboratory pictured below will be in operation this year in Baltimore, helping Westinghouse engineers solve problems in oceanographic and ASW research.

Built by the Westinghouse Ordnance Department, the new laboratory is one of the largest and best-equipped privately-owned facilities of its kind. It is 225 feet long and 175 feet wide. The air conditioned instrument house boasts on a 3½ million gallon lake, 25 feet deep and with an anechoic lining.

The laboratory will advance the develop-

ment of a wide range of Westinghouse underwater acoustic equipment. Included are transducers, detection systems, weapon homing and guidance systems, and high and low frequency sonar devices.

Underwater acoustic systems built by Westinghouse are a part of various Navy weapon systems. This new acoustic laboratory at Baltimore will bring increased contributions to this vital area of American strength.

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INTRINSIC CHANGES in molecular engineering techniques are required to break the asymptotic barrier of systems complexity versus systems reliability. The barrier for Motorola's solid state electronics capability has been to carefully lead down as the vapor phase formation of an epitaxially grown, single-layer crystal. At Motorola, scientists and engineers have been brought together in an expertly equipped organization under single leadership. These molecular specialists have at their command the disciplines associated with semiconductor, epitaxial growth crystals, deposition, thin-film, surface passivation and encapsulation, electronic ceramics, and equipment and systems design. They are pioneers in the design of solid state equipment and systems of superior reliability and performance. At Motorola-integrated circuit research and development, using thin-film and semiconductor hybrids and pure morphological circuit structures, have opened new areas of microscopic technology to practical application. If your applications problems lie within the parameters of solid state electronics, look to Motorola for practical solutions.

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New available is a low cost, assembly dynamical fallout shelter that provides vital protection against nuclear radiation. It's an asbestos panel structure that can easily be erected in any ordinary basement. Compact, the unit accommodates 6 adults but covers a floor area of only 9' x 12". Versatile, it can be used as a storm shelter, photo dark room, game room, or office. Developed over a period of three years in cooperation with nuclear physicists, industrial design firms and university consultants, the unit bears the seal of acceptance of the Office of Civil Defense. Produced by Kelsey Division, Kelsey Hayes Company, 100 E. Olney Ave., Philadelphia, Pa., the shelter is available through various retail outlets and local building supply dealers.



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Required Reading

We have just finished a book that should be required reading for even critics of this magazine interested in its future. It is "The Narrow Margin," written by two Englishmen, Derek Wood and Derek Dempsey, and published in England, Canada and this country by the McGraw-Hill Book Co. We have read almost all the books published on the Battle of Britain from the first wartime paperback of The Ministry of Information Office through the post-war volumes, memoirs and the numerous del attempts of both U.S. and British authors to distill the essence of the battle.

"The Narrow Margin" is the first successful attempt to put the full story of the Battle of Britain between the lead covers of a book with all of its significance, ranging from the technical and political troubles that trailed through the early thirties through the grave and significant decisions made in the heat of the battle to the nature of the final, narrow margin of victory that saved a nation.

The Battle of Britain, truly understood, has vast significance for every citizen of the nation today. For it Britain alone carried the spear that could stop the march of Nazi Germany through Western civilization in 1940, so today a similar responsibility rests on this country in the face of the Communist challenge. All the significant elements that determined victory and defeat in the Battle of Britain are present in the military expertise that confronts the Western world and its Communist challenges today. This is true despite the immediate comparison of time and distance in the new weapons spawned in acceleration of a technology that was just getting underway when it was put to its first test in the summer of 1940 over southwestern England.

Technical Controversies Continue

The technical controversies that raged so hotly British and German circles during the war flared up about specific lines of development to prove still have their counterparts in the Kremlin and the Pentagon today. While their significance in the Battle of Britain has now become crystal clear, their portent for our future must again await the verdict of history. For example, in England, the battle in 1935 between constant rotation or whether to pursue radar or reliance on the most promising solution to the problem of long range aircraft detection was as significant to the outcome as the final cluster of machine gun between opposing Messer jets and Spitfires five years later. What enormous significance in retrospect, grew from the death of the German Gen. Walter Wever in 1936. For he was the brain and backbone of the German effort to develop strategic armor, and at the time of his death, the prototypes of the four-engined Junkers Ju 89 and the Dornier Do 19 bomber were ready for flight testing with performance capabilities of giving a large bomb-

load to Scotland and the Dniep from German bases. What would the outcome of the Battle of Britain have been if the main assault had been carried by these types instead of the lightly loaded, lightly armed and short-ranged Do 17s, Ju 88s and the 110s? German strategic responses died with Wever and, essentially, it was Marshal Goering, who later made so many errors of command in the Battle of Britain, who signed the order to begin the German first engine bomber program.

What all these questions or possible answers heard could have made the decision, two days after a service test pilot's report to re-equip all Messer-powered Royal Air Force fighters with the constant-speed propellers developed by Hamilton Standard and built under license by de Havilland, and then equip over 1,000 Spitfires and Hurricanes with this vital device for high-altitude combat in less than 60 days while the Battle of Britain was in its most critical phase?

The fascinating game of electronic countermeasures, which began with the North Sea voyages of the Graf Zeppelin in the summer of 1939 and included such code devices in hospital X-ray machines as emergency jammers is still being fought today as one of the hottest sides of the cold war.

Lessons From History

All of the political arguments in England over the cost of rearmament during the late thirties have the same resonance as the debate debates of the past five years. The blindness of intelligence on both sides when Winston Churchill's network, organized as a private debate, proved more efficient than either official British or German bureaucracy, also have current echoes. And Russia's Marshal Goering's vocal underestimation of how large a fighter force it would take to subdue the RAF Fighters Command should be studied by the Pentagon planners, who are calculating by the last fraction of a kiloton just how much is enough for an future struggle between nuclear powers.

But perhaps the biggest lesson to be drawn from this first description of the Battle of Britain is that it was not a simple test of personal valor and skill between pilots when the battle was joined. It was a test of man's stretching back through the years when they were concerned, organized and developed, and was finally defeated on the matter of the staff of the command as he operated them in the months of crucial battle, and the determination and response of the command and back seat support required to sustain them.

For it was true today as it was in the summer of 1940 when Air Marshal Sir Hugh Dowding said it, that "the war will be won by science, thoughtfully applied to operational requirements." Read the book, and think!

—Robert Hobb

Starfighters
scramble
on BFG
fabric tread
tires...

selected for ability to take 2-ton load variations, speeds to 270 mph.

A fast ship in the air, The Lockheed Starfighter is also mighty quick on the runway, with takeoff speeds ranging from 212 mph up to an extreme of 270 mph. The Starfighter's flexibility and its ability to carry heavy loads requires tires that can take two-ton load variations, and speeds up to 270 mph under adverse takeoff conditions. The BFG fabric tread design has proved it can stand up to these punishing conditions, reducing road cutting and making tread separation virtually impossible. Multiple nylon plies are laid right into the rubber tread stack. This reduces internal tread flexing and wobbling. These tires are being supplied on the F104 for the U.S. Air Force, West German Republic, and Canada. For complete information, contact B F Goodrich Aviation Products, a division of The B F Goodrich Company, Dept. AD-11A Akron, Ohio.

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300,000 psi bolting... and how you can use it

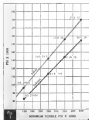


Fig. 1 Comparison of EWB 30 with standard bolt, showing significant increase in tensile shear and fatigue

Look back 10 brief years and you realize that if in the new SPS EWB 30 you have a bolt which has nearly the weight of steel fastening in half! Offsetting twice the tensile strength and three times the fatigue endurance of an MS 30004 Series bolt—the die cast precast 300,000 psi superbolt—now permits steel to be a point comparable to titanium in the strength-to-weight spectrum.

All Physics Used Proportionally

Fig. 2 depicts the evolution of the EWB 30 in terms of increasing tensile, shear and fatigue values. Most significant is the fact that the EWB 30 offers a preponderance increase above lower strength bolts in static and dynamic strength.

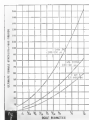


Fig. 2 Evolution of the strength-to-weight ratio, showing preponderance gain over today's use of the EWB 30 in place of lower strength bolts

Primarily because its tensile, shear and fatigue have been increased in proportion, you can safely compare the EWB 30 with its predecessors in terms of tensile strength vs. bolt diameter. And from such a comparison (Fig. 2) you can reasonably determine the reduction of, say, a 1/2 in. EWB 30 for a 3/8 in. MS 30012 at a tensile level of approximately 65,000 lb.

Weight Savings Approach 50%

Design implications of the new EWB 30 are therefore far-reaching, to say the least. As an example, take the hypothetical aircraft below—a single seat fighter with an airframe weight of 10,000 lb. Assume A we have designed around MS 30004 Series bolts; in B, around the new EWB 30.



Wing area (sq ft)	150
Wing span (ft)	30
Wing thickness (in)	1.5
Wing weight (lb)	1,500
Wing strength (lb)	1,500
Wing length (ft)	1.5
Wing weight per ft	1,000



Wing area (sq ft)	150
Wing span (ft)	30
Wing thickness (in)	1.5
Wing weight (lb)	1,500
Wing strength (lb)	1,500
Wing length (ft)	1.5
Wing weight per ft	1,000

Thus you can go from 15 in. MS 30004 to 1/2 in. EWB 30 and actually save 50% weight. And because EWB 30 shear and fatigue are in proportion, you can do it without risk. Result: a reduction of 50 lb—or approximately 45%—in fighter weight alone!

Enhanced Component Design
Savings in fighter weight are not the only design opportunity offered by the new EWB 30. Associated components—flanges, "T" sections, etc.—also can be manufactured in our hypersonic joint, for example, the smaller EWB 30 permits the web of the flange member to be reduced 12%, flange length reduced 17%. In space vehicles or missiles, where weight is of paramount importance, these small savings on large-scale joints can be significant.

A Complete Fastening System

In designing with this new ultra-high-strength bolt, full utilization of the advantages can only be accomplished by power design and installation. That SPS offers with the EWB 30 a related "fastening system," a special-design socket wrench which prevents damage of the wrenching unit by contacting the less valuable reduction of the wrenching unit, and a precast reducing socket (PSI) which assures accurate preloading to 80% of body yield strength.

EWB 30 bolts and companion FN 30 flanges are available only for the EWB 30 in sizes #10-12 to #14. Also available is a shear bolt and rail companion in preloading (EWB 30) and flange head sizes (SPT 30, SPT 30) for 100,000 psi tensile strength. For more information write: Airway/Military Division, SPS, STANDARD PRECAST STEEL CO., BENTONVILLE, PENNSYLVANIA • SANTA ANA, CALIFORNIA • WHEELING, ALABAMA • GAITHERSBURG, TEXAS • SAN DIEGO, CALIF. • SEATTLE, WASH. • YAKESVILLE, N.Y. • WILKINSON, MISS.



New SPS EWB 30 bolt and companion FN 30 flange. Tensile strength: 300,000 psi



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INDUSTRY OBSERVER

► Requests for proposals for development of USAF's constant range ballistic missile are expected to be issued to industry bidders about Dec. 1. Intense competition is expected for airborne work and solid propellant motors.

► Proposals for a study of a three-man, long-range, low-altitude, low-speed aircraft are expected to be issued to industry bidders about Dec. 1. The study is expected to be issued, not exceeding \$500,000 in cost.

► Brawl T-155, a three-man, long-range, low-altitude, low-speed aircraft, is scheduled to make its first flight next week. The aircraft is being developed by the USAF's Tactical Air Command (TAC) and is expected to be in service by 1980.

► National Aeronautics and Space Administration has decided to keep Project Gemini, which was to have been a two-man, low-altitude, low-speed aircraft, in service. The project was canceled in 1969, but NASA has decided to keep it in service. The project was canceled in 1969, but NASA has decided to keep it in service.

► Since inception of the USAF-North American B-70 supersonic bomber program, various difficulties in obtaining accurate values of the B-70's performance have been reported. The B-70's performance is expected to be in the range of 10,000 to 12,000 mph at 70,000 ft.

► Radioactive isotope techniques that could lead to a series of aerospace designs, for example, at high altitudes will be incorporated under a forthcoming Aeronautical Sciences Division study. Requests for proposals were circulated to various firms recently. Study will cover everything, instrumentation and utilization of radioactive isotopes.

► Canadian CL-41, two-place basic jet trainer has been Mach 7.75 in level flight, according to the Royal Canadian Air Force requirement of March 75.

► Chrysler Corp. intends to organize a new Space Division under its Defense and Special Products Group if it wins either of the Saturn launch vehicle two contracts, rather than handle the work through its Vehicle Division.

► Navy's Bureau of Weapons has prepared the data for submission of proposals for the VAX advanced fighter based on bonded studies by North American, Douglas and Boeing Companies have been told to continue their investigations. Proposals originally were due on Nov. 15.

► Ames Research Foundation is seeking support among private industry and universities for a large-scale research program to explore possibilities of obtaining useful devices from space reconnaissance satellites.

► Failure for USAF's proposed Star nuclear-powered rocket engine designed to cruise at Mach 5 at very low altitudes, within 10 ft of the surface.

► Cost estimates on orbital Dryden boost glider flights, using the Titan III as a booster (AW Nov. 5, p. 36), are due to be submitted to USAF on Nov. 13 by Boeing Co. Defense Department's failure to accept the proposed acquisition of Dryden boost glider flights has resulted in a substantial cutback in Boeing engineers on the project.

► Prof. T. L. Vandenburgh, AFRL, will be involved in handling USAF and NASA Titan-Agassid, USAF project for orbital launch, but NASA performs critical assembly, using a rocket engine.

TFX Fighter Award Due Feb. 1

Washington—Award of a contract for development of the TPN medical lighter for the Air Force and Navy will be made by Feb. 1. Contractors who submit proposals by the Dec. 6 deadline will be allowed one hour each for oral presentations on Dec. 12 and 13.

Military specifications accompanying proposal requests from the USMC Automated Systems Division clearly delineate two separate albeit differing in size and performance requirements for Air Force and Navy systems.

A two-engine aircraft is specified, with the notation that the engines currently considered in existing requirements are the Pratt & Whitney TF30, the Allison AE100 and the General Electric MB701 (AW Oct. 35 p. 36).

In order to meet performance specifications, the document states that the results generated using a portable network are not as reliable. The results need have all weather analysis.

It must be capable of spraying from a pivoted metal plank in soil field. Distribution in field operations may be provided by almost several methods: drogue parachute or other method which a contractor can develop.

Air Force requirements call for a 60,000-lb aircraft with length not specified. General belief is that it will be from 73 to 75 ft. long. Takeoff and landing must be limited to 1,000 ft. or less. Cruise radius for a low approach, high-altitude delivery and low-altitude escape is set at 500 nmi. Air Force range required is 1,300 nmi. ■

USAF also wants a speed capability of Mach 2.2 cruise at 50,000 ft. and a high speed of Mach 2.5. For low level missions a speed range of Mach 0.9 to Mach 1.2 for 100 mi. or less is desired.

Nancy has specified speeds at which it'll sit at sea level and Mach 2.0 at best altitude, which is considered to be about 65,000 ft. It must be able to carry out 1,000 lb loads for a constant radius of 110 in, and must be able to handle an action for 70 hours. Length is to be 56 ft and gross weight 55,000 lb.

Nary any support processes for intaglio's laminating and oriented laminates. Full service must be possible from stretch centers of the CVA 19 (Forsvald class, CVA 41 (Centi), and CVA 45 (Enterprise)). Lateral service—stretching intaglio must be possible for CVA 41 (Midway), CVA 45 (Randall D. Kasevich) and the CVA 19 (Hirock class), which is also called the 77C construction of the lone Enterprise class centers. The Centi class may have TEN spontaneous capability because it might reach out to intaglio (2.68 ft. long, only 19 ft. less than the Forsvald class). It also has stronger intaglio and stretching gear than the other two shops of the Midway class.

British Aircraft Industry Workers Agitate for Government Backing

London—British secret employees participated in a one-hour sit-in strike Monday protesting lack of government support of the British secret mission, and the dangerous transport in particular, while delegates from 20 far-flung east-west members of the Redwood

About 9,000 members of the Association of Supermarket Staffs, Excessives and Technicians took an hour off at their desks. Upshot of the protest was that the Labor Party will schedule a House debate on arguments for building a new airport.

Stole by the technicians was another factor, but a lack of government support of the creative industry. More striking was the recent doubling of the Herald-Sun's Group's quote month from after two fruitless years of trying for government contracts.

Harley Seldley claims about 125,000 systems, of which 70,000 are in-

calved in aircraft production. But dropping its space research team was only part of the picture: the group has had one new airplane sale in three months, a lone Dornier AlphaStar.

• **The Havilland's Portsmouth plant**, which does subassembly work on the Comair and Sea Vista, is shutting down, putting nearly 1,500 employees out of work. Only the aircraft shop will remain in operation for TriStar transport work.

*Cathack also is in store for de Havilland's Chester plant, which assembles Decca and Harmon and does Conquest subassembly work. Problems are not so acute at de Havilland's main Conquest assembly plant at Hatfield, where workmen will be phased into the Trident program when Conquest eventually leaves the production line.

- **Cluster Analysis**, which has been merged with **Argument Whitworth**.

has laid off 100 persons in two weeks, mostly at the main works at Gloucester. This plant has mostly been converting inventory to Mk. 9 configuration (afterburning and hardware for night refueling) and performing some substantial work within the group.

Hawker Siddeley currently is building the Armstrong Whitworth 660 for the Royal Air Force, the Vulcan V bomber, Blackburn NA 39 for the Royal Navy, 24 Tridents for British European Airways, and the Conquest 4 and Sea Vision. Some of these plants will absorb men laid off at others, company says.

Policy Talk

Top executives at Hawker Siddeley and other aircraft groups are known to be considering high-level talks with government officials, to set down a policy plan for the British industry, based on a wider survey of its potential. Important decisions will be the amount of government support in financing research and development. Then, the companies will build the product, giving the government a percentage of profits.

At the moment Hawker Siddley prefers to say that it is assessing its operations with a view to streamlining and is trying to achieve efficiency by adopting the labor force to current conditions.

Last July, Sri Theerth Sengupta, group chairman, told stockholders that the group had written off \$42 million on coal mining designs and development and said at that time that Hunkar Sed deder needed government support for future projects.

White Paper Released

Pravica, admits confusion by each of India's side on the often-documented defense Papez of April, 1957, when the first Minister of Supply Duncan Sandhu and the U.K.'s future policy would stress nuclear and missile defense, and the government was dropping development of a nuclear weapons bomber. Fighters would be replaced by a ground force missile system.

After that, Soudys became the architect of the grouping of the industry, mostly into Hawker Siddalls, British Aircraft Corp and Westland. But Blue Steel was dropped as a weapon. Douglas Thiess became the main defence

Only two fighters are under development—the Hawkeye Siddle, P.1127 VTOL for the NATO competition, and British Aircraft Corp.'s TSR.2 strike fighter. Royal Air Force is considering designs for a tactical transport replacement for the Hercules, but

Treasury has not yet made any funds available for production.



Hiller Displays New Six-Place Helicopter

Miller Aircraft Corp.'s newly displayed in glass turboprop helicopter incorporates tail boom (top) from H23H4832 series, including isolated stabilizer from H57H23H29+ model. Photo at right shows Pratt & Whitney PT6 turboprop engine used in 500 chp isolated power. All glass access panels can be secured or opened no longer. Turbine access is provided for special maintenance, allowing fly into the cabin.



Beacon Study Would Double Control Cost

Air traffic task force urges primary role for radar; implementation of plan would require \$500 million.

Washington—New plan for utilization of the nation's airspace, approved to cost \$500 million over the next five years but being proposed by the Project Beacon task force on air traffic control. This is approximately twice as much as the Federal Aviation Agency has budgeted as a part of its Five Year Plan.

The long-awaited Beacon report, released this week, says the recommended program should be implemented within five years to meet the demands of a growing air traffic control system that is expected to increase about 300% by 1975. The task force, headed by Richard L. Hoag, estimated that a prototype air traffic control system of the type it proposed could be ready for initial trials within 18 months.

Major changes recommended by the task force include:

- Radar should become the primary source of traffic control with radar control being the primary defense for controllers and flight program strips serving as secondary aids. Non-radar radar coverage would be obtained by combining existing Sage air defense radar and FAA en route and terminal area radar (AWZ Reg. 7, p. 40, Sept. 16, p. 38, NIA, p. 3, 20).
- Extension of positive control to all aircraft flying below 14,500 ft. (above 12,000 ft. was high altitude coverage) and to all aircraft above 3,000 ft. on high altitude enroute.) To make these areas accessible to pilots without radar, area strips, the report must establish third category (A) and fourth category (B) Visual Rules. These positive control areas would not require instrument flight.
- Segregation of controlled and uncontrolled traffic on high altitude enroute and congested terminal areas with speed limits on enroute flight rules (VFR) flights. In congested terminal areas, aircraft should be segregated into categories for performance and speed differential. Large should be separated.
- Radar beacon transponders should be mandatory for all aircraft below 17,500 ft. (now required only at altitudes below 10,000 ft. that land at one-tailed airports within designated enroute terminal areas, when a low cost shortage, beacon becomes available).
- Automatic altitude reporting, using air data computers, in progress, currently in trials, should find discussion and to automatic, since computerized radar is required for such altitude reporting.
- Automatic computers, both for enroute and terminal area portions of the system, to protect flight plans, since

distances, noise control, profile, gross weight, information, clearance, landing sequence and other data, and to assist in the traffic control. Many of these are functions which the data processing center (DPC), under development by the FAA, has the task to perform. It is recommended that the Beacon report recommend that general purpose digital computers be used to reduce cost, instead of the special purpose ones developed under the General Purpose Plan. The report adds that each of the development work in the DPC project will be directly applicable to the recommended system. In particular, work on radar display and terminal area flow control and sequencing will be valuable.

• FAA should undertake a long-range program to develop an integrated air traffic approach first and building on that, the task could be tackled in the future. The report suggests that this system incorporate a four function device to decrease peak load, during the final step, of an instrument approach and the last step, of a non-instrument approach. This last step is a series of task, not just a procedure.

Beacon Approval

Washington—Paradise Kennedy, first week said Federal Aviation Agency last week said NIA should be kept in mind to give and such recommendations of the Project Beacon report, which he believes will cover the areas program forward rapidly and efficiently. He said that the report should design a series of action steps, which he believes are the six defense areas which he believes are the most important in meeting air traffic control requirements.

• New emphasis should be placed on increasing the aircraft handling capability of airports by improving ground support, supporting aircraft in the type, which possible, and installing instrument approach aids at suitable airports to direct general aviation aircraft from major metropolitan terminals.

The Beacon report said that the air-traffic, search and do dependent budget of \$67 million per year, should be adequate to cover work on the new system, but that "considerable major work of current development program will be necessary."

Air Defense Integration

One of the most controversial portions of the report is its recommendation to merge the functions of Sage air defense computer for traffic control purposes on a joint basis. It is a level limitation on such joint use in the fact that Sage does not have the data in computer capability to handle the terminal area portion of the traffic control problem.

The initial proposal contained by the Hoag Committee was to use Sage computers to handle only the high altitude portion of the traffic control task. This would have required FAA to provide its own computers for the remainder of the control situation, it considered unacceptably and operating systems and would have created a problem because of the division of traffic control between the two systems.

A later proposal considered one that could handle enroute flight rules (IFR) traffic at all altitudes and both IFR and VFR traffic above 14,500 ft. Under this plan, FAA would have to acquire its own computer facilities for terminal area operations.

If this plan were adopted, substantial modifications and additions would be required in the Sage computer system. Sage, which handles enroute traffic, is being developed and its current changes made, the Beacon report says. Even then the Sage system would not be able to handle peak air traffic load and on defense load conditions the report concludes.

There are other operational changes planned. The digital data processing approach to air traffic control before they are introduced into Sage center computers, which the ability of terminal controllers to track, search through slow and ground delays. It also shows various other of these changes, some

from the controller's scope, some from which is useful to controllers and pilots.

Instead, Project Beacon recommends that FAA use only the air defense radar of the Sage system and primary and secondary radar on route and terminal area computer facilities. Estimated cost of this is only \$100 million, even in initial investment and \$100 million more per year in operating and search, more than the cost of enroute Sage facilities in proposed. Annual system operating cost is estimated at \$355 million.

The Hoag Committee concluded that this extra cost would be more than justified. It would leave the FAA's air defense control system in a "ready" state, which would be a major change in Sage air defense system that now be needed to accommodate new air defense concepts, such as decentralized, such as decentralized, such as decentralized.

If the Defense Department should decide to abandon Sage at some future date in favor of decentralized systems, the FAA then would be free to use the Sage system for air defense control. The report says that the FAA should be free to use the Sage system for air defense control.

Detention Suggestions

The report recommends use of computer and automatic data processing equipment to perform many of the services currently performed by FAA's present DPC development. However, the report's study on computer use in which flight program strips are used as a "primary" procedure reference with automatic updating of the strip by a primary load controlled by a computer, would be abandoned under the Beacon recommendations.

Instead, a small telephone console on each controller position would provide pilot out a full set of updated flight strips, read out of that position. The strips would be changed manually in the console and then sent to the console.

Contrary to views expressed at the recent meeting of the Air Traffic Control Council, the Beacon report says that several decisions of possible flight plan conflicts allow two controllers to use the facilities of the controller and become a more difficult task in air traffic control.

It therefore recommends use of computer for conflict prediction.

The moderately high cost of computers, coupled with the need to provide sufficient storage capacity for air traffic control, suggests that such systems are not yet ready and could be made by reducing the present number of traffic control centers the report said. But it notes that this saving might be partially offset by cost of

additional facilities needed for forecasting route data, cost greater decrease for an approach to air traffic control, which would be absorbed in other costs elsewhere present.

Terminal Procedures

The report recommends that major terminal areas such as New York, Los Angeles, Chicago and Washington "present the greatest hazards and create the most delays" in air traffic. Controllers should be able to descend VFR and IFR, and so also large numbers of aircraft with which having performance characteristics are comparable, the report said.

To avoid this, the report recommends segregating enroute and terminal area operations by establishing a "vertical" structure of approach and departure control" leading upward to terminal area, down to enroute area. This structure must be feasible of quick change in case with local airport problems. It would not add to existing workloads by forcing pilots to enter enroute, follow complex, clearance, change route frequencies rapidly, and so on, and to maintain proper VFR or IFR status.

The current system would require down to support at the center of a circle with a 30-mi. dia. (100 mi. at high altitudes). This approach corridor and its extension would be used and only visible according to at least one "provisional plan" developed by local controllers. Under the terminal VFR, controllers would receive traffic information from enroute controllers as required in each terminal. In good weather, all traffic enroute, an additional controller would direct VFR aircraft with low performance capabilities. In poor weather, it should be a separate section of the terminal Working clearance, the first controller might be

aligned with the airport's ILS location and assigned to adjust jet descending for an approach to the terminal area. If the weather deteriorates, the aircraft would be directed to intermediate, aircraft such as the Douglas DC-6 in Lockheed Electra. Second controller in terminal area would be required to use ILS and other aids to descend about 10 mi. from the terminal threshold, while low altitude arrival traffic would use the third controller, which in turn to take up the approach runway. VFR, holding, flight, in this corridor would eliminate routine maneuvering close to the airport.

The report called the merging of IFR traffic with enroute traffic as a "major" change in air traffic control, particularly in the "vertical" structure. The report said that pilots who fly in ground reference should be serviced, allowed to IFR pilots in the air, and so on, the report said. The CTR clearance, maintain aircraft altitude, and so on, upon traffic control to furnish information from all other traffic.

Helicopter Routes

In recognition of IFR being in helicopters, which FAA estimates will begin in 1965, should be anticipated in the setting of special control rules in terminal areas. The report said that, in these, work could be done in the 600 to 1,100 ft. altitude corridor, which could be used to avoid enroute, enroute with other terminal area traffic.

In 1967-75, the report predicted, helicopter traffic will be in and out of about 60 locations in the New York area alone. It is possible that 50 heliports may be in use at a given moment, all handling either a single mission or a series of missions, in which, the report said, separation is not in impossible.

In a such, precise means of aerial navigation must be developed by aircraft.

Project Beacon task force was composed of Hoag, who is vice president of engineering for American Telephone & Telegraph Co., USAF Col. James E. Ande, Jr., chief of the interception system, and a group of officials at the Air Force, who are in charge of air traffic control and logistics. Henry D. Corbin, president of Corbin Aircraft Co., George C. Corbin, vice president and deputy technical director of Airborne Instruments Laboratories, James Dugan, associate technical of the research council of The Rand Corp., William Lefkowitz, vice president for equipment research, American Airlines, Robert C. Newcomb, director of Bell Telephone Co., and Norman Zinn, Radio Laboratory, and National Research, manager of advanced computer simulation in the data system division of International Business Machines Corp.

TWA 720B Failure

Lakehurst, N.J.—The No. 1 engine of a TWA World Airways 720B jet took off with a fuel leak, but the engine was not damaged, according to the FAA. The engine was a Pratt & Whitney JT8D turbofan engine. Model 720B, in the latest model, the engine took off at the rate of 100,000 lb. per hour, and the engine was not damaged, according to the FAA.

The accident, which occurred on a New York City flight, took place at 15,000 ft. over the Bronx, N.Y., on May 10. An emergency descent was made, with the engine being shut down in 10,000 ft. to activate the passenger cabin oxygen mask system. None of the passengers was injured and the engine landed without incident at Logan International Airport in Boston. The cause of the accident was not found on the survey of the Albany airport.

Trunklines to Ask Fare Increase Regardless of Boyd's Opposition

Washington—Major trunklines, optimistic about their chances for higher fares in 1967, are in a series of new fare plans, application in the end of this month despite a determination of the Civil Aeronautics Board Chairman Alvin B. Boyd (AWN Nov. 6, p. 37). The current strategy calls for the filing of a variety of fare increases, expecting that the Board will approve an across-the-board increase to offset the industry's heavy losses from pre-negotiated and coach fares. As of late last week, United Air Lines and National Air Lines were the only carriers which had filed for increases.

Meanwhile, American Airlines asked CAB permission to abandon its traditional "month ends" fare plan for a "calendar" excursion fare and flexible fare plan by Dec. 15. In addition to American's request, a group of airline companies and districts on pre-negotiated fares were referred to the Board last week. A majority of the letters was reported to be highly critical of pre-negotiated fares and opposed a decision to drop several of them in the near future.

Pre-negotiated fares in general have failed to generate enough traffic to recoup the losses from a division of first-class fares, American said.

The airline complained that increased traffic volume also causes an increase in operational costs. It pointed out that while its total traffic volume is now 100% greater than it was 10 years ago, American cost it is a far worse financial proposition.

The industry leans on its transportation commission fare alone, but for September, were estimated at high as \$203,000, the airline said.

Eastern Air Lines and its district fare are an established source for increased significant new business. The airline said it feared dropping the month fare plan, fourth fare plan and the industry's 10% discount to encourage flying first class.

The airline complained that it con-

siders its Air Ben and Air Shuttle as critical new service which should not be abandoned. It pointed out that since they have been diverting large amounts of highway traffic and creating new air traffic. Both operations have been financially profitable. The airline said Boeing 747s and second tier jets which the airline offers passengers from New York to Washington, San Antonio to Houston and New Orleans were adapted as a competitive measure, and would be dropped if Eastern competition would arise, the airline said.

Pre-negotiated fares should be eliminated to develop optimum traffic as to schedule, would travel in a manner that would protect their use by business travelers who travel in any event, the carrier said. The company, it said, it will offer its customers, offer some fares to Florida next year, but in conducting a new round trip excursion fare for a calendar year.

Eastern also took issue with a "no frills" common coach fare which would be approximately 25% below its present jet coach fares on a majority of the Continental route between Boston and Texas World Airlines has also filed for the fare as a competitive measure.

There is a change of service on one air route, but the airline said it would remain in less revenue at a time when all carriers agreed they need more. Eastern said. The time also was attempted in several North Atlantic carrier cases for the past several years, but was abandoned in two months and unprofitable, the airline said.

Intervention Expected In PAA-ALPA Fight

Washington—White House intervention was expected here last week to end a threatened strike by Pan American World Airways pilots by the end of a midnight Nov. 10 deadline announced by the Air Line Pilots Assn. Close similarity of the Pan Am-ALPA dispute with that of a Trans World Airlines pilots' dispute now being in progress by a presidential emergency board guaranteed speculation that both problems might be investigated by the same board (AWN Nov. 6, p. 36).

ALPA and the strike was called because of failure to reach agreement with the airline over supply and working conditions after 35 months of negotiations. ALPA and disagreements included Pan American's refusal to

abide by the findings of a neutral fact finder, appointed by voluntary agreement between the union and the company.

Major area of disagreement, the union said, has been Pan American's failure to provide lower monthly flight time, linehaul, plus limitations on flight duty and night duty during a 24-hr period. While ALPA insists on domestic operations as limited by contract to a monthly flight time of 55 hr, the union said, Pan American flight time on international routes is figured on a monthly basis permitting a "bumping" of flight time in any month.

ALPA contends members have been forced to fly as much as 120 hr, a 50% increase, this January. It wants a specific monthly flight time limitation and a limit on pilots' flight duty deck time to 8 hr in any 24 hr period.

In other labor developments, the Flight Engineers International Assn., the National Mediation Board and representatives of union airlines concluded a meeting called to discuss the reorganization of the Passenger Commission.

The seven carriers were believed to have generally agreed to consider solutions, beginning to settle the current labor issues with the carrier's union.

Texas World Airlines' management also was studying NMB recommendations involving operations of the Airline Navigation Assn. distance of the contract. William E. Kline, the union's chief negotiator, said the use of dual dispatch system equipment on TWA flights ALPA declined to comment on the NMB report, which recommended several measures: pay increases, job replacement and other conditions that were applied if the use of dispatch should result in the displacement of navigators in the cockpit.

Northeast Merger

New York—Joint merger proposal by Eastern, National and Midwest Airlines to Northeast was withdrawn "for the present" last week in a letter from the three carriers to David K. Smith, chief of Northeast.

The carriers said the merger discussions could not be resolved satisfactorily after making recommendations. They said, however, that the move did not imply that a new effort would be made to merge.

Another source of possible merger for Northeast apparently was closed when TWA said to withdraw its an active partnership in the Florida route around one and advised the CAB that it does not plan to file a proposal to merge with Northeast.



Swissair Conqair 990 Used in FAA Certification Program

Swissair Conqair 990 took off from Lanthier Field in San Diego, Calif., on FAA certification test flight. The aircraft is being used to test the 990's communications and navigation equipment and prototype. A second Swissair 990 will be used in the FAA certification and reliability program. The airline will receive its first 990 in November and will take delivery on all seven it has ordered by the end of February 1967. Crew training will begin in December.

ALPA Elections May Shape Sayen's Role

Washington—Air Line Pilots Assn. members prepared and scheduled to elect President Clinton N. Sayen's quill ball "organization," has scheduled two elections that promise to put those who would retain Sayen in office against those who would elect a new president.

Outcome of these contests may prove decisive in determining how long Sayen serves as ALPA president. It is a letter to members (AWN Nov. 6, p. 36) Sayen asked in his "address" to his officers and later than the fall of 1967. But if Sayen supporters should win the forthcoming elections, some pilots he has, there is a strong possibility this drive will be extended.

If anti-Sayen candidates are elected, his term of office may be cut short by ALPA's executive committee, which is known to have considered a formal resolution calling for Sayen's prompt resignation.

First Test

First ALPA officer to be elected will be a vote pander to represent the union's third largest membership. But this office is scheduled to close Nov. 15. Capt. A. B. Carney of United Air Lines, the incumbent, generally agrees with Sayen on ALPA issues and is expected to run again for the vice presidency.

But reelection of Carney, while important to Sayen, probably will not alter the present balance of power on ALPA's executive committee.

The executive committee, composed of the union's eight top officers plus Sayen, is known to be split along three general lines.

• For Sayen, Capt. D. J. Smith of Trans World Airlines, Inc., Capt. H. A. Adams of United Air Lines, group vice

president and Capt. Carney. • Against Sayen, Capt. John Carroll of TWA, first vice president, Capt. Paul Myers of American Airlines, secretary, Capt. Al Clark of TWA, group vice president and Capt. A. B. Adams of United Air Lines, first vice president.

Paul Adams, vice president of the group in the month elected vice president of group under W. T. Balliett of Eastern Air Lines. According to ALPA officials, Balliett vote declined the executive committee when it met on Nov. 1 to consider a resolution requesting Sayen's immediate resignation, and offered \$500 as an opportunity to back the drive. He then, this meeting, Sayen called a surprise, group conference at which he announced his "don't do it" stance to the "pushers."

The compromise, plan that finally accepted during the Nov. 1 conference, called for immediate resignation for Sayen's resignation to the union's 300-member board of directors and scheduled a meeting of this group for Nov. 29. The executive committee then decided that Sayen should be "retained as a consultant for a reasonable period, not less than three months, following the election of his successor" to create an orderly transition.

ALPA's executive committee, which the executive committee will be the party to call special meetings of the board of directors. The executive through a vote of no confidence, also may request the resignation of an officer but such requests are not advisable. Whether the committee, as opposed to the board of directors, can oust the president's resignation is a point of contention within ALPA.

The political complexion of the

union's executive committee also may be altered by the election of a vice president to represent ALPA's recently formed Student and Studentess Division. This officer, who is to sit on the executive committee, will be selected by the flight attendants' own board of directors after their body has been elected by local councils of the Student and Studentess Divisions.

Flight Attendants' Support

Flight attendants affiliated with ALPA generally hold Sayen in high regard. For this reason, it is probable that their vice president will probably strengthen Sayen's position within the union.

Election of the Student and Studentess Division vice president probably will take place at the Nov. 29 election of the board of directors. Flight attendants believe that the latter move be based to provide debate on a succession to Sayen.

Specialists of other pilots who favor replacing Sayen contend on a basis of every day begins with the incumbent president's giving control of the executive committee through the Student and Studentess divisions. The executive committee, as a result, would be unable to pass any resolution requesting Sayen's resignation. His permanent board upon Sayen's resignation is in office, but supporters might then convene a meeting of the board of directors to oust the incumbent. The union's membership, which Sayen's resignation should be rejected. Such a vote could be interpreted as an expression of confidence in Sayen's resignation and result in his agreeing to serve out a term of office that runs for their next year.

"Selective" Fare Changes?

Civil Aeronautics Board Chairman Alvin B. Boyd's opposition on fares did not completely eliminate hope on the part of United Air Lines and others in the opinion of Andrew M. DeVany, executive vice president of the union.

"It certainly puts a damper on a general upward adjustment," DeVany said. "But it is not a total bar. It may leave some room for selective adjustments."

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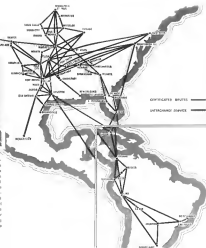
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Charles E. Wood, President, Braniff International Airways has this to say of the decision to order the One-Eleven: "After devoting more than a year to comparative analysis, it is our conclusion that the BAC One-Eleven is the most ideal jet to adapt to the routes on which we plan to operate them. The economy of the BAC One-Eleven combined with its operating characteristics makes it ideally suitable for an operator with our kind of route now which must of the flying at segments of 500 miles or less. We already have large plans for the longer hauls. The BAC One-Eleven will bring economical and comfortable jet travel to the customers who make the shorter flights."



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Transatlantic Traffic Slump Continues

By Glenn Gammage

New York—North Atlantic airlines are moving into their winter off-season with little hope of a sharp increase in traffic to offset last summer's slump, which resulted in an increase of only 3% in scheduled passengers in the face of a 77% increase in capacity.

Last year at this time, when most of the carriers were operating large-scale jet flights for the first off-summer period, bookings were reported as up for the winter, with some such as Pan Am and Aer Lingua (ENR Nov. 9, 1960, p. 46). As it turned out, the North Atlantic airlines carried 31% more passengers in the first quarter of 1960 than in the previous full period. Carriers, however, were 33% for the quarter.

An Aviation Week survey of all coast bookings for the all season indicates a level generally only slightly higher than last year at this time. Carriers will be up again but not as drastically as during the last off-summer.

Bookings are less reliable than they used to be as an indicator of traffic because of the tendency to book late winter service, that the figures after change for the better a few days before a particular flight. However, little of the optimism evident last year—that the 15-day extension for war going in for the first time—seems reflected in this season's growth rate, at best second month.

The slump in traffic growth, critical when linked with the tight increase in seat capacity, began last May. For the

four post-summer months, June through September, the scheduled North Atlantic air traffic carried 917,774 passengers, an increase of 14.3% over the same period in 1959. Of this, 1,048,000 passengers rose from 1,273,455 seats to 1,747,065, a 34% load factor in both directions of flight for the 1960 period. This was a drop from a similar load factor in summer, 1960, of 68.5% in both directions.

First class traffic was heaviest last, dropping 14% to a total of 95,225 passengers for the four months. Economic passengers totaled 822,729, a 9% increase.

For the nine months ending last September, scheduled traffic was up 8% to 1,464,674 passengers, and scheduled capacity was up 41% to 2,098,190 seats.

Charter Operations

Charter operations which present some controversial aspects, seemed to be the main reason for an increase of 73% among the scheduled carriers to a total of 151,567 passengers. Some airline officials, proponents of lower scheduled fares, feel that the charter business is a way of keeping the capacity and offering lower fares through the back door. Also, some question exists as to whether charters are actually reported to International Air Transport Association. In this view, as it declassifies members of charter passengers and up to the scheduled passenger totals.

Among the carriers reporting charters for June, July and August were British

Overseas Airways Corp., with 262 additional seats; Lufthansa, with 75; KLM with 54; Pan Am with 383; SAS, with 32; and TWA, with 41.

Last summer's traffic, both in capacity offered and traffic carried, varied considerably among the individual carriers. Some examples:

• Pan Am increased a 14% increase in passengers for the four months to a total of 181,071. Capacity rose 46%. Pan Am estimates its capacity for the winter season will be about 75% greater than last year's, but the increase in the first quarter beginning Dec. 30 is 15% ahead of bookings for the same period last year.

• TWA traffic dropped 10% from the previous summer to a total of 1,461,693 passengers. Capacity was up 5.2% to 195,190 seats. Among the controversial factors cited by TWA are the increased transatlantic capacity of foreign carriers and then jet fleet, entrance of new carriers in the market, competition from governmental carriers operating charter under blanket contracts.

TWA's capacity this winter will be down slightly from last year from about 3,750 weekly seats in each direction beginning Nov. 1, to 3,100 seats. As of the same date, bookings for November were running about 7% higher and about 5% lower respectively. TWA estimates its capacity for the winter will be lower by some 20% than last year, but this year's last.

• BOAC traffic also was down slightly, from 133,475 to 127,725 passengers. Capacity was up 25% for the four months. For the entire summer season BOAC plans to offer about 15,860 seat-bound seats, an increase of about 35%.

A major automobile factor cited by BOAC is the Air American direction of U. S. government. According to Alan Duggan, BOAC's general manager in New York, the British carrier expects to increase its transatlantic capacity next summer by 7% during August 1961-42 jet equipment to other routes.

• KLM increased its capacity by 16% to 129,106 seats. Traffic rose from 61,908 to 67,679 passengers. Capacity for the winter season will be about 2,742 seats a week, or from about 1,168 seats on the average, last year. Bookings per carrier are about the same as last year, but KLM says it really is too early to estimate with any accuracy.

• Lufthansa increased its traffic by 17% to 177,331 passengers and increased its capacity by 22% to 105,214 seats. Lufthansa has an expansion in the winter that is absolutely dependent on an improvement in the political situation. This airline is particularly hard hit because the current political situation is an

hindrance to the Berlin-Washington-London air, along with BOAC and other foreign carriers, enter the Air American program as a participant source of traffic loss. The German airline's capacity in traffic rose 33.3% last summer. Capacity was up 9% to 117,727 seats. SAS plans to offset about the same capacity this winter as last. Bookings are reported to slightly up over this time last year.

• Air France increased its capacity by 40% to 127,727 seats. This winter's capacity will be about 51% greater than last year's. Bookings were up about 13% as of Nov. 5. Airbus has reports about 10% ahead of last year's.

Controllers Question Future Value Of Various Air Traffic Measures

By David H. Hoffman

Many air traffic controllers have begun to question whether this is a place, in any future, control system for computers that can only present to flight progress strips, devices designed to justify conflict control, and the present flightless status situation.

Comments of these device came during the Air Traffic Control Association's annual meeting last week when controllers' inability to control the ATC "system" was to be replaced by a computerized version of the Project Beacon task force (see p. 14). The details of the Beacon study show months of study, but the controller's view is not reflected in the Oct. 20 Nov. 1 ATCA conference.

At an informal workshop on "automation evaluation," controllers made it clear that any plan to install additional "workload" equipment, similar to the one, the Remington Rand Unicom now in use at the Federal Aviation Agency Air Route Traffic Control Center (ARTCC) would not be well received.

• Extra expense of having additional computers to print but not update, flight progress strips would draw funds from projects aimed at developing sea automatic ATC system with greater capability.

• Expanded use of flight progress strips is difficult to reconcile with the expanded use of radar in controlling air traffic. Similar with the, which is not in fact, controllers want to focus their attention on radar scope rather than on strips printed by a computer.

• Position of landing the computer with data, traffic control, and flight progress strips into better and distributing the burden to numerous carrier sectors in some case, requires more personnel than would be required to print and distribute the strips to land.

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North Atlantic Passenger Traffic

June Through September, 1960

Air Line	Flights	Seats	Passengers	Load Factor
Air France	112	34,136	7,403	21%
Aer Lingua	168	22,250	7,740	35%
Airbus	998	75,870	42,662	56%
BOAC	1,964	249,975	127,725	51%
Canadian Pacific	116	37,320	17,319	47%
DL	275	15,984	21,827	68%
British	227	14,574	6,656	46%
KLM	375	40,601	25,774	64%
Interim	1,129	139,186	67,679	52%
Lufthansa	264	395,736	97,351	25%
Pan Am	2,746	349,070	214,879	61%
Qantas	48	4,182	2,945	70%
Sabena	507	76,569	33,049	43%
SAS	876	113,727	63,367	56%
Swire	528	67,824	32,814	48%
TWA	710	92,325	51,244	55%
Total	14,015	1,761,081	917,754	52%

Note: Figures International Airlines began transatlantic service June 16. Figures are not yet available.

Local Service Carrier Expansion Criticized

By William H. Gargoy

Briefed, Com.—Growing criticism of the local service carrier for under market was a controversial issue at an aviation symposium here, sponsored by the Connecticut General Life Insurance Co.

Chief Executive Board Chairman Alan S. Bond, also made a major address which dealt with fare and margin (AVT Nov. 6, p. 37), also commented on the local service carrier in his report, but in response to questions here.

"If the airlines were making the local service this year in 1955," he said, "the Board might look with a good deal of interest on the local service plan. But I, for one, would not want to put the traffic in a business expanding the unbalanced local carrier."

With the drive of local service carriers has come also a tendency to alter terminology. The local service carrier now are sometimes being called regional carriers and a new class of carrier is being postulated and referred to as third-tier carriers. These would be a new type of airline, probably operating light twin-engine aircraft, and would take out immediately from the current but would not necessarily be local service Douglas DC-3, Cessna Martin or Fairchild F-27 equipment.

An aside, Eastern Air Lines vice president, Casparius, Charles F. Bond, said the term regional carrier is desirable local service airlines in a description of a short-range jet transport (AVT Nov. 6, p. 41). He included Eastern as the airlines because, "having out of the line of regional carriers, it is out of its main step shows it to be a large regional air carrier."

Local Service Issues

The local service issue was most completely stated because the principal critic, Donald W. Nisop, president of Northeast Airlines, was unable to appear on his scheduled panel. However, his statement was circulated at the meeting and was known to other participants.

In it, Nisop was critical of the Board's approval of the Civil Aeronautics Board, contending it had nullified all the progress the Board had made in recent years in strengthening the non-medium-size trunk carrier, including the southern transcontinental airlines. Lack of adequate equal economic opportunity for the small airline forces against the transport group, but he is not representative for these economic reasons.

"More recently, however," he said

"that, three airlines forced themselves subjected to attack from beneath—the additional threat of destruction of their revenues by the introduction of local air. They are indeed in danger of being caught between the upper millstone of the large trunkline and the lower millstone of the local service carrier."

Nisop stated the claims of rapid growth of the local carriers, but he also pointed to reversals in volume.

These figures indicated: "In mid-1954, local service carriers took to space—that the growth in the volume of traffic carried by these carriers in national parks, the product of adding more and more route miles and points served, routes which are, quite evidently, less expensive to serve. The obvious consequence is a severely left wheel in achieving future projections."

A second factor contributing negatively to the size of the industry left unbalanced is the provision of excessive service by the local service carriers in some markets.

Short-Range Aircraft

Local service carriers are already achieving substantial passenger growth and to support such service are testing new aircraft. As a result, short haul but high density carriers are being built by the manufacturers Nisop said.

"Such an evolution, if not wisely guided by a combination of subsidy," he said, "could result in another group of medium-sized airlines, carriers with the same problems which are as urgently requiring attention in the case of the existing airlines carriers."

Despite all this criticism of a third tier of carriers, such a situation is made likely in the guidelines of Big Four trunklines, the seven medium-size trunkline and the local service carrier, Nisop asserted. And despite all the talk of merger as the only effective remedy for the ill of the industry, Nisop contended.

More thoughtful criticism will reveal that a series of mergers, dissolving the already depleted ranks of medium-sized carriers and concentrating the airline industry in the hands of a few giants would be neither a cure all nor in the national interest."

The spokesman for the local service carriers, Robert E. Peach, president of Mohawk Airlines, did not explicitly reply to Nisop but he noted:

- Regulation of the local service segment of the industry has been almost non-existent. I don't believe," he said, "that we are oversteering on this issue of size so to have oversteering short haul carriers."
- Regulation by definition has also

truly split the airline industry into trunk and local carriers, though the problems each faces are common to both.

• Subsidy is not determined by the airlines or even CAB, but by Congress as a benefit to the local community.

"It's not up to us to defend subsidy," Peach said. "It's up to us to adjust it so it provides the best level of service possible for the industry allocated."

Better ATC Needed

Emphasizing that Mohawk wants to get off the date, Peach pointed to such problems as traffic control as one possibility for a solution. At present, Mohawk's 100-200 air carrier-length trips leaving the New York area for example, are subject to the same delay as a transcontinental jet flight.

"If we could get some form of ATC," Peach said, "in which the extent of delay would be proportional to the length of trip, Mohawk could achieve direct operating expense 15%." Total subsidy need would disappear. "There could be a profit, and possibly even a reduction in fares."

One type of problem Peach cited in one striking local, trunk, and local. "It's about time," he said, "that CAB and the Air Transport Association, the conference this will set in motion."

Peach's views that all airlines are on a common level, and an agreement have been made. He told participants that he felt the local service carriers represented a completely different situation than the trunk.

Not all of those in the local service carriers to enter some profitable carriers can reach encouragement from other speakers. Commented William B. Hines of South Illinois & Co., a New York manufacturer, looking for "I am optimistic that the local service carrier, without competition and with a higher rate structure than the trunk, can get on a self-supporting basis (without subsidy) period. However, they don't get too fancy ideas."

Some of them already are beginning to see that, in order to maintain and expand their profit margins, they must be allowed to compete in high-density traffic markets. If this is permitted, the basic problem of excessive competition will never be solved.

There are plenty of markets that are rich enough to earn profits for quite a number of carriers, but the profitability of a single route should not determine how many carriers should be allowed to fly over it. The overall profitability of each route should be the determining factor.



Leading jet of An-14 "Fidelio" three light transport aircraft (left) for the transport from rough fields (right). Tractor and other vehicles have been equipped to provide safe low speed approach to the runway on road that will not support other than the above photo (right) for operation from rough fields.

Soviet An-14, An-24 Transports Designed For Rough Runways

Three An-24 twin-engine transport in Soviet design, shown in the photograph, entered 15 months ago (AVT Nov. 11, 1955, p. 41). Additional version has been announced to enter under development as An-14 shown on one of the photos. An-14 is a four-engine, six to 12 F-27 Fokker Friendship class for operation from and over water. These will carry 32-40 passengers.



Off The Drawing Board And....Into The Air

From the time that the new YS-11 was first placed on the drawing board, it was decided that equipment would be placed upon several important features which were missing in earlier type airplanes. Best economy for short haul operations, with greater payload and shorter take-off requirements are combined with the highest standards of safety and performance under all climatic conditions. Added to these, the refinement of the new Rich-Royce Dart R.D.10 turboprop engines (current top performance). The new YS-11 is now ready to prove all of these points in operation. The prototype is scheduled to fly early next year and production models will be placed on domestic service lines in Japan during the summer of 1963.

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Super Broussard May Serve Fiji's Needs

By E. L. Doty

Sure, Fiji-Erie need for a turboprop transport aircraft capable of operating into rough fields under tropical conditions has led Fiji Airways into serious consideration of the French-built Super Broussard.

Although no final decision has been made on a new aircraft to supplement Fiji's fleet of three de Havilland Hornets, two Doves and one Skimmer, operators now say that the Super Broussard (ASN June 5 p. 60) is the only aircraft available with the performance characteristics Fiji needs for its passenger and mail service.

Final decision rests with the technical development section of Queen's Empire Airways, which is joint owner of Fiji with British Overseas Airways and TEAL of New Zealand, and under the agreement, it operational supervisor of Fiji.

In its evaluation of Fiji's fleet requirements, the Queen's technical group has eliminated the French-built Potez 540 turboprop transport as too small. The de Havilland 121 composite-type transport now in production, priced by five alternative turboprop engines, has been all but dropped from consideration for the same reason.

Ingenuity Problem

Several airlines have been approached by de Havilland with a design proposal for a larger version of the HS, the 730, but the British manufacturer is apparently still undecided as to whether it will move ahead with the project. This aircraft, with a 20-26 passenger payload and a thrust weight of 75,000 lb, would be ideally suited to the needs of Fiji. However, the airline is drawing away from the turboprop-powered transport because of a concern over possible delays in getting the turboprop engines which are operating from price in isolated fields.

The Fokker Friendship turboprop is considered too large for Fiji because of its low aircraft utilization, due to low-density traffic, possibly due to the terrain and lack of navigational aids in the area it serves. Other short-haul aircraft, such as the Cessna 440 or the Martin 404, are also considered for Fiji's operation.

The Douglas DC-119 was not recommended but it is not being considered because of the need for modifying the Fiji fleet with turbine engine aircraft. Thus, the Super Broussard appears to be the answer to Fiji's requirements. The aircraft, powered by two Duxton IV turboprop engines each with 540 hp,

at takeoff, has a passenger cabin with a useful volume of 1,194 cu ft. Cruising speed with maximum continuous power is 210 kt. Takeoff ground run is 900 ft.; landing ground distance without an obstacle is 220 ft. Maximum range is 835 stat. mi.

Unique Operation

While Fiji's operations are unique in contrast to most short-haul or local service airlines in other parts of the world, it is one of a growing number of feeder airline services being developed to provide connecting services from isolated island airports to and from the big islands which lack the facilities of a main-line carrier.

Fiji's three 15-passenger de Havilland Hornets are the backbone of its operation. It conducts two daily round-trip services between Suva, capital of the Fiji Islands and one of the largest airports in the part of the Pacific, and Nandi, location of the main airport serving the island's jet flights as a refueling and maintenance base.

Nandi with its 30,000-ft. runway, is fully equipped with navigation aids, including ILS, VOR, and radar terminal control. It is the only airport on the Fiji island at which Fiji has not installed airborne equipment concepts. In fact, these facilities were it cannot be used because.

Suva airport has a standard surface runway but its main navigation aid is a non-directional beacon. All other airports served by Fiji are equipped with standard beacons but runway aids are more than standard locally.

All flights into the island group are flown by dual-engine aircraft and airports consistently poor weather in the more remote areas between Suva and Nandi, the airline maintains a high standard of operating efficiency.

In-Flight Features

In-flight engine failures have been at a minimum.

Fiji serves three communities in the island chain, with the Horn in a regular schedule. Two flights, Upu and Matei, which are without landing strips, are served by the Horn which has been equipped with provisions for amphibious operations. During the month of August Fiji served 1,400 passengers, 1,000 Suva and Nandi and a total of 1,000 passengers in other islands.

In addition to the other island service Fiji is entering into a regional type operation in the South Pacific area, which is expected to be used for new equipment. Regular service is now operated weekly between Fiji and Tonga, area, 495 stat. mi. from Suva. A similar

service to Faleolo in Western Samoa is being started this month to give that area its first scheduled air service.

Fiji plans to begin, possibly before the end of the year, a service to Honiara in Guadalcanal. Charter service to this area has been operated since 1960. Eventually the airline would like to expand its service into Timor which would give it a completely integrated network of air services in the southeast Pacific region. With the amount of traffic predicted in this region, a 20 to 24 passenger aircraft would suit the operation.

Bongai is an essential factor since no airport served on the overwater regional operation is handicapped by an alternate airport. All available landing strips are given without regard to size type and construction. Development in airports is not slow. No port served by Fiji, beyond Nandi and Suva is equipped with refueling facilities.

For in-flight operations, Fiji enters the seat with four IS to 12 in panels for galleys and lavatories and a navigation position forward. Other navigation equipment carried on the Hornets in addition to standard flight instruments are two ADF's, a Hughes TA-100 magnetic slant, Decca's drift indicator and navigational charts. As with Fiji operations official put it, "what else is there we can use?"

Queen's Manager

Chen Rehder is manager of Fiji Airways and directs all its operations. Rehder, a Queen's official on assignment to Fiji, has been able to build Fiji into a successful operation during the past two years with no interference from its airline rivals.

For all practical purposes, Fiji is a separate entity.

Fiji Airways was founded in 1952 by Harold Gatty, who managed service with two de Havilland Dugon Regale airplanes. Just before his death Gatty added the two de Havilland three-engine Doves which Fiji still operates in addition to the Horn.

In March, 1958, Queen purchased Fiji Airways from the Gatty estate. Because of political and strategic interest in the area, in Britain and New Zealand, Queen retained the Horn and TEAL to participate in the operation. On Jan. 1, 1960, a joint agreement was signed whereby each carrier held a one-third ownership in Fiji with Queen assuming the responsibility for the management of the company.

With 70 employees, a large number of three native Fijians, Fiji Airways handles all its own maintenance and major airframe and engine overhaul.



LINE-UP of 1,200 Mena aircraft at Prague-Kovice Airport. The four-engine Aero Mena from the backbone of CSA's rapidly growing air services. Recently 10 were added to CSA's air fleet first to replace some of the carrier's aging three-engine Aero 440.

Czech Airline to Expand Air Taxi Service

Prague-CSA, Czechoslovak Airlines, hopes to extend its growing scheduled skid as two operations beyond its current borders within the next future.

While waiting on implementation of this expansion of its air service beyond Czechoslovakia for the first time, CSA's 1,200 Mena aircraft, has grown steadily since its inception in June 1951. Current figures for the air tax service—the first of an expansion within Europe, according to CSA—include:

- Total sales (from 1951, 201,509) had increased to 1,132,215 in 1980.

1980. Total mileage for the first eight months of this year 874,454.

- Number of hours flown in 1951, 1,272. 1980, 5,079. First eight months of this year, 5,616.
- Number of passengers carried in 1951, 1,502. 1980, 54,155. First eight months of this year 13,075.

• Total passenger ton miles flown in 1951, 40,581. 1980, 363,453. First eight months of this year, 268,507.

All the present rate of increase CSA expects operational results to reach an all-time high by the end of the year. In step with traffic growth, CSA is

strengthening and modernizing its fleet of light aircraft for air taxi duty. Each this year the airline took delivery of 10 Lear to increase 1,200 Mena's on an improved version as the 1,100 Mena series, which CSA already operates there in addition to 15 three to four-seat Aero 440.

To demonstrate the Mena's medium-range capability on the eastern of the north extension of the company's air operations, an aircraft of the 1,200 Mena series this summer made a nonstop cross-Channel flight from Prague to England. A problem for the carrier and the aircraft made the return flight from Gatwick, England, South England, to Prague in 4 hr 37 min. On landing at Prague, it had an hour's active taxi.

Fuel Economy

Tabul fuel economy of the 1,200 Mena is 110 U.S. gal. The result is powered by two engines Czech Valtair Mena 317 equipped developing an output of 215 hp and fitted with direct fuel injection and compressor. Cruising speed is approximately 475 mph, range 1,000 mi. The 1,084 is capable of taking off at landing on very short runways or unimproved ground.

Center of CSA's air tax services is Prague-Baran. Airport, home base of all CSA operations. In addition, at a total of about 100 airports, airports including unimproved grass strips, the company maintains about 150 vehicles are two centers at strategic points throughout the country. Although these were 70 tons and smaller planes, most of them are a year-round basis, although many of the smaller ones are temporary in ground facilities have to be closed to air traffic during the winter months because of adverse weather.

Study Finds Convenience of Auto Lures Many From Airline Travel

Washington-Preference of auto travel for the auto tax, have evolved into such a marketing concept as the industry finds this increasing threat to its growth potential (AW May 1, p. 35).

Auditors of a recent marketing survey conducted in Florida revealed that 71% of motorists interviewed preferred auto transportation because of overall convenience, even though a majority had flown before, according to the Air Transport Data, which made the survey in cooperation with the Florida Development Commission last July and August.

An Aviation Corp. compiled 252 of the 913 previous interviews indicated that major reasons for choosing auto transportation, beyond the speed of travel, was its comfort and relaxation.

ATA does not consider the switch machine enough a deterrent as to make change in marketing concepts but feels additional surveys should be conducted first in other areas of high population growth such as Arizona and California.

Misunderstood Cost

ATA points out that this survey also disclosed that 57% of the auto travel group considered that their trip would have cost it less than an airline. Of the remainder, 38% estimated that, and 37% were about right.

The study indicated the need for a full-cost, advertising campaign to clarify the cost of airline travel and place some emphasis on its comfort and relaxation, ATA feels.

ATA said the survey revealed these other statistics which should be studied further to determine their significance:

- 66% of the auto users had taken an air trip and 61% indicated they had not traveled in general.
- 90% of the motorists considered air travel safer than auto travel, and 46% indicated air transportation is as safe as car travel. Only 5% of the air travelers admitted any loss of sleep.
- 62% of the motorists drove from 50 to 1,000 miles to reach Florida. 15% exceeded 1,000 miles and the balance up to 500 miles.
- 10% of the auto users traveled alone or with only one other person and the remainder in groups of three or more. In comparison, 57% of the air travelers traveled alone or with one other person.
- 17% of the motorists had annual mileage of \$50,000 or more as compared with 54% of the air travelers.

The survey also noted that 54% of the auto travelers were on vacation as compared with 42% of those flying. 15% of the auto group were on business, or on business and pleasure trips as compared with 31% of the airline users.

Auto Advantage Cited

Of those who preferred auto travel because of convenience, 38% revealed that they had flown before, and 18% cited the benefits of having a car available at their destination. Only 16% of the hotel motorists interviewed said they chose the auto because of economy.

Among airline users, 75% indicated the ease and freedom of security, 34% complained about flight delays and terminal waits.

However, 90% estimated that it would have cost them more to fly, or slightly less, to make their trip by car, but close to use as transportation is used.

The ATA analysis noted that auto travel into the Florida market has increased 35% during the year, while air travel and car usage has fallen about 1%.

ATA said that airlines have little chance of increasing their share of this market unless "basic changes" can be made in the airline industry and attitudes about air travel.

CAB Rules Frontier May Drop Routing

Washington-Frontier Airlines, operating under suspension in the Nebraska state courts of its appeal 11 between Omaha and Council Bluffs, has been authorized to drop service to all points on the routing after Dec. 19.

The CAB's Nebraska Board began the service suspension in August, 1980 and advised Frontier to suspend service on September 11 until 90 days after the final decision on the case. In the meantime, the Nebraska Department of Aeronautics was granted an injunction to keep courts asking Frontier serve the route.

CAB said that the experimental nature of the route was proved by the fact that for the year ending June 30, 1980, only 6,000 passengers had been generated instead of an anticipated 14,000 at which cost variously estimated by Boone Cavanaugh at \$64 per passenger and Frontier at \$51 per passenger. Boone's original estimate was 50 per passenger.

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CSA to Add Tu-104A to Fleet

Prague-CSA, Czechoslovak Airlines, expects to add another Russian-built Tu-104A, 70 passenger twin jet, to its fleet at the end of the year. The additional Tu-104A will be used to step up the frequency of the carrier's international jet services.

These include line service to fly a week between Prague and Moscow, three between Prague and Paris and one to London. The fourth, and first Tu-104A, flight scheduled only last year as a seasonal summer flight to Bangkok and Doha via Cairo and London (AW Oct. 17, 1968, p. 49), now calls at Doha, Saudi Arabia, where CSA was granted commercial rights before the August this year. Meanwhile, the Czech carrier operated the Prague to Doha route via Warsaw to meet its seasonal high seasonal traffic. CSA also hopes to open a new service from Prague to Havana in the near future (AW June 9, p. 32) had details as to the line of flight to be met, frequency of operation or whether the company expects eventually to obtain landing rights at Havana or the Aeronautics are still being negotiated.

Between June and September this year, CSA for the first time operated Tu-104A jet and 14 H (including charter service to Prague, Rome and Vienna). Regular service generally to the growing number of Czech tourists to and from the south seas in the Black Sea was during the peak summer months. These extra flights were operated on an average of twice a day, both ways.

CSA's Tu-104A is being converted from five original 70 passenger capacity to 50 passenger (reductions). Cabin interior also is being redesigned and CSA says that the new color scheme in panel shades is addition to greatly improved design and quality of the units should increase passenger comfort considerably. The conversion and replacement of Tu-104A is already completed, the remaining three will have to undergo the same improvements by the end of the year.

AIRLINE OBSERVER

► International Brotherhood of Teamsters organizers are concentrating more effort on Trans World Airlines pilots and direct department employees, with emphasis on the airline's Chicago operations. Success at TWA would put the Halliburton team into four airlines. Teamsters have gained a foothold at Pan American World Airways, where the union represents 800 stock clerks at Winston Air Lines, with 300 mechanics and the Flying Tiger Line, with 91 stewards.

► Need for early planning to create airline route structure capable of supporting expensive transport operations is a key consideration behind Civil Aeronautics Board Chairman New S. Berke's statement against weight of carriers and the desirability of sole two carrier per route (AWN No. 6, p. 37). Another reason is that CAB believes this situation would make it much easier to fix responsibility for adequacy of service in case of complaints from consumers.

► Transport operated by trucklines employing black overland routes have bettered up services than the same type of aircraft operated by carriers using continuous maintenance material, local service personnel and used equipment are concluding. The black routes provide all-in-one service as long as necessary to accomplish overland.

► Federal Aviation Agency's "new" jet advance service is being broadened to include Military Air Transport Service jets operating along the high altitude airway network in continental U.S. The service was jet pilots flying above 20,000 ft. of conflicting traffic.

► Rolls Royce predicts that steadily climbing sales between overland (TBO) of major airline budgets (about \$1.5 billion) will result in the airlines subcontracting almost all engine overhaul to independent specialists. If that is to be achieved economically, an airline shop must be established at least as engines work. The British manufacturer believes. But to give this act, on line on a 1,000-hr TBO engine with 85% average overhaul life, an airline must operate about 50 four-engine jets before it can justify an overhaul facility.

► Studies ordered by Federal Aviation Agency show that positive control of air traffic management through a given run requires significantly increased workload on controllers. A study revealed that controllers using traditional techniques at Oakland, Calif., expended about seven-fifths the effort to move a similar traffic volume in controller using positive control techniques in the Indianapolis Center. Study was conducted by Canterbury and Co.

► Joint United Air Lines/RCA evaluation of airborne data as a smooth turning device has come to a halt after extensive low altitude testing in a North Carolina. RCA and United determined that the problems of ground clutter and inadequate side lobe vegetation produced spurious returns on the airborne scope. United recently dropped a plan to install the modified radar equipment on a jet to learn whether freight misbehavior was true, when 15,000 ft.

► Swain is planning a series of new route extensions to Afghanistan and the Sudan, under recent agreements signed with these countries by the State government.

► Sikorsky S-61L, two turbine helicopter not certificated for airline use by the Federal Aviation Agency, but work. Los Angeles Airlines and Chicago Helicopter Airlines have each ordered one of the new aircraft.

► Field fix will be available for an inlet casing cracking problem on the Pratt & Whitney JT3D turbofan engine. It consists of strengthening attachment joints between the inlet cases and the throat. Another problem with the engine—had numerous cracking—also has been fixed. Engines in production now have all manifold joints fixed with a nickel gold alloy. Engines in service are modified by means of welded sleeves over the manifold.

SHORTLINES

► American and Eastern airlines' proposed \$152 joint route fare between Miami and San Francisco via Chicago—equivalent to fare between the nearest points on the most direct southern transcontinental route—has been suspended by Civil Aeronautics Board until Jan. 30, 1961, while it investigates whether the route is warranted in view of the increased distance. Joint first class fares over the same route were also suspended.

► Coastal Airlines in contrast to the tandem, reports it has been "de-lighted" with the response to its route fare plan after its first month in effect. The carrier says 340 young people took advantage of the fare in account for 15% of the total loadings for the month.

► Delta Air Lines reports a net income of \$153,711 for the third quarter of 1960. Figure includes \$265,900 from the sale of equipment. Last year's net income for the same period was \$151,611 which included \$502,008 on the sale of equipment. Total operating income for the third quarter was up over \$10 million—1,670 increase over the same period last year.

► Federal Aviation Agency has approved a modification change in the leading edge of DC-8 jet transport wings which gives a range increase and higher speed. Change, involving deepening the leading edge of the wing and increasing the chord 47", has been approved for DC-8s already delivered as well as those scheduled for delivery.

► KLM Royal Dutch Airlines will cut its ticket rates on its "fast new service line" plus from 6% per year to 4%. Plus is to become effective 30 days after KLM files with Civil Aeronautics Board.

► Lake Central Airlines reports it carried 97% passengers during September, but an 82% increase over the same month last year. Much of the increase was due to additional routes serving the West Virginia area. Washington, D.C., and Baltimore, granted since last December.

► Trans World Airlines has asked Civil Aeronautics Board to approve a fare plan that would allow children, personnel in groups of 10 or more to fly basic in Christmas for less than half the regular round trip fare. Sample reductions: Paris to New York, \$210 round trip in stead of \$435; Frankfurt New York, \$275 round of \$561. Plan would be in effect from Dec. 1 to Jan. 31.

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Airline Income and Expenses—August, 1961

(IN DOLLARS)

	Passenger Revenue	U.S. Mail	Freight	Charters	Total Operating Revenue	Total Operating Expenses	Net Income Before Taxes
DOMESTIC TRUNKS							
American	33,571,284	476,884	399,376	2,346,837	36,494,381	29,825,424	6,668,957
Boeing	1,544,025	168,318	71,340	245,378	1,989,061	1,189,340	809,721
Continental	1,113,960	197,000	43,000	16,000	1,470,000	1,137,000	333,000
Delta	11,419,083	254,000	140,000	443,000	12,476,000	11,904,000	572,000
Eastern	19,762,385	464,881	1,007,232	60,946	21,294,453	13,476,136	7,818,317
Northwest	6,307,221	164,081	35,873	306,790	7,013,965	5,490,000	1,523,965
Pan American	1,280,000	1,000,000	400,000	1,000,000	4,680,000	3,680,000	1,000,000
Southwest	1,433,972	198,332	490,404	26,179	2,159,887	1,591,136	568,751
Texas Eastern	1,281,536	1,000,000	400,000	1,000,000	4,680,000	3,680,000	1,000,000
United	42,084,211	1,461,234	2,729,712	190,737	46,465,904	40,434,485	6,031,419
Western	6,085,271	174,148	198,517	102,343	6,560,289	5,727,771	832,518
INTERNATIONAL							
American	545,819	6,879	332	45,740	647,818	597,047	50,771
Boeing	164,819	22,815	1,000	1,000	1,811,334	1,000,000	811,334
Continental	338,435	3,300	17,133	2,428	361,496	323,464	38,032
Delta	10,800	1,000	1,000	1,000	174,800	122,000	52,800
Eastern	2,801,111	30,367	147,577	1,000	3,044,055	2,478,543	565,512
Northwest	185,202	1,000	1,000	1,000	178,204	170,472	7,732
Pan American	3,827,181	200,000	1,000	1,000	4,029,181	3,827,000	202,181
Southwest	36,919,000	2,479,000	4,343,000	3,461,000	46,142,000	40,434,000	5,708,000
United	658,890	1,000	1,000	1,000	660,890	585,000	75,890
Western	19,810,000	1,844,000	1,000	1,000	21,655,000	20,427,000	1,228,000
Alaska	5,002,000	272,000	1,000	1,000	5,275,000	4,714,000	561,000
Alaska	7,136,000	1,843,000	1,000	1,000	9,000,000	8,427,000	573,000
Panama	42,332	1,000	1,000	1,000	43,332	42,000	1,332
South Pacific	2,437,200	865,416	742,513	192,849	3,917,978	3,015,400	902,578
Texas Eastern	3,273,120	11,000	6,400	1,000	3,291,520	2,497,133	794,387
United	169,332	4,328	12,617	1,000	187,277	169,332	17,945
LOCAL SERVICE							
Alaska	1,224,227	24,120	22,878	42,898	1,314,123	1,273,333	40,790
Boeing	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Continental	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Delta	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Eastern	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Northwest	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Pan American	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Southwest	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Texas Eastern	477,764	4,064	5,348	5,438	492,614	415,400	77,214
United	477,764	4,064	5,348	5,438	492,614	415,400	77,214
Western	477,764	4,064	5,348	5,438	492,614	415,400	77,214
HAWAIIAN LINES							
Alaska	821,281	3,874	5,812	5,812	836,779	695,322	141,457
Boeing	912,183	3,438	5,812	5,812	921,245	763,334	157,911
CARGO LINES							
Boeing	4,493	4,493	4,493	4,493	17,143,836	17,143,836	0
Continental	364,414	418,345	418,345	418,345	1,480,443	1,480,443	0
Delta	1,193,341	1,193,341	1,193,341	1,193,341	1,193,341	1,193,341	0
HELICOPTER LINES							
Chicago Helicopter	136,488	136,488	136,488	136,488	272,976	272,976	0
Los Angeles Helicopter	21,425	21,425	21,425	21,425	42,850	42,850	0
New York Helicopter	181,722	4,003	1,708	2,692	189,125	189,125	0
ALASKA LINES							
Alaska Airlines	265,577	51,538	876	54,161	362,152	328,414	33,738
Alaska Central	145,933	10,300	1,000	1,000	158,233	158,233	0
Continental	22,239	70,813	70,813	70,813	141,635	141,635	0
Delta	39,344	830	2,782	2,782	45,718	45,718	0
Eastern	1,030,273	10,100	5,812	133,411	1,180,596	1,083,480	97,116
Northwest	265,511	49,542	47,014	46,776	369,843	334,544	35,299
Pacific Northwest	12,123	1,000	1,000	1,000	14,123	14,123	0
Southwest	262,728	77,838	53,349	118,740	444,645	417,483	27,162

† Net profit or loss = Passenger and freight revenue less operating expenses for Alaska Airlines, Delta, Eastern and Northwest Airlines. Excludes Alaska Airlines, Delta, Eastern and Northwest Airlines. Excludes Alaska Airlines, Delta, Eastern and Northwest Airlines. Excludes Alaska Airlines, Delta, Eastern and Northwest Airlines.

† Property (including freight, excess baggage and express)



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TURBOPROPPED TRAINER will be built all here in the EH1191 Vespene trainer. All turboprop-powered aircraft currently in service with the Swiss air force are of British manufacture, but French designed Mirage III's are on order.

Swiss Air Force—Part I

Swiss Air Force Problems Many, Varied

By Cecil Browder

Berna—Swiss air force, beset by financial strings, political constraints, a dominant army and major reliance upon "worldwide warms" scenic pilots is struggling to maintain a coastal force capable of protecting its nation's borders in an age of increasing costs and advancing technology.

For many concerned to direct any other accepted air force structure, the problems of the Schweizerische Flugwaffe and the means it seeks now to try and meet them are unique.

The combination of this traditionally neutral nation prohibits a standing armed force of consequence during peacetime, or the creation of one, one commanding general, for that matter, may be thought might present a possible threat to the federal government.

The air forces (armed for training—enough for each pilot to fire 12 folding air rockets per year) and for maintenance are actually leased and controlled for the most part by the army. Its own size is determined by the semi-closed support but and domestic battlefield requirements need if there are plans to gain.

The Swiss air force is composed of several units, though don't recognize what an aircraft is in an aerial display. They have never had to fight a war where it was need.

The small, professional core of the Swiss air force recognizes the need, however, and its attempts to find aircraft that can adequately meet the air force's close support demands as well as provide some interest opportunities combine to make most of the decrease in equipment orders a consequence of last. Another contributing factor is the knowledge that the aircraft will be placed largely in the hands of reserve pilots, who will work here only 70 to 80 hr of flying time per year to maintain proficiency and combat capability.

The Dassault Mirage III's, latest and most advanced aircraft to be ordered for the air force was not the first on the performance list of a number of planes ordered over a two-year period including the Grumman F-111F, the Lockheed F-104 and Sweden's Saab Draken. It can be used, however, for close support and intercept as well as combat, but a respectable range and versatility. "It is a very, very plane to be," according to an air force official.

Then, this add "one one of the most complicated."

One other aircraft among those tested "was better than the pilot's point of view, but its price was too high and its acceleration at altitude too slow."

Moving Mirage financing is a major problem in itself in that the annual Swiss defense budget is laid out as a package, with no specific amounts con-

tributed for the entire use of the air force, etc.

The army also is modernizing and, under the present structure, its needs come first. Therefore the appearance of the first Mirage will be delayed until the 1961-64 period, with lack of funds the main deterrent. Although planned beyond production of the air force and engine in Switzerland also contributes to the delay to a lesser extent. Delivery of the last of the 100 aircraft now on order is scheduled to take place in 1967.

Under current air force procurement policies, which stipulate that aircraft should have a 10% surplus value, the Mirage will maintain an operational capability until well into the late 1970s.

For the moment the air force, with about 100 jet aircraft in various degrees of obsolescence that could be driven into the hands of those and some three percent, given its major strength from Switzerland's traditional ally, the Western Allies, says, which will, however, provide the basic element for its medium-range, single-engine, fighter aircraft used in the combat planes and whose efforts are in leading steps for pilots trained to make strong, low-altitude, low-level attacks while pulling a heavy load of in and sometimes higher.

Current equipment consists of 30 Russian Il-28s on the front line de-

signed into five squadrons, 250 de Havilland Venoms and 110 Vampires, both of which are rapidly approaching their 10-year air service life, with the Swiss divided into units of 31 and 5 squadrons respectively.

Primary role of the Il-28 is that of intercepter, while the older Venoms and Vampires concentrate on close support duty, but also are expected to them to act as fighters. The Il-28s, in fact, must be capable of substituting the close-support function when necessary.

Security Jeopardized

Although Swiss national policy is one of neutrality, Swiss officials are under no illusion that a Soviet attack from the east, conventional or nuclear, will fail to place its security as an issue, possibly or that a modern air force is not a fortress, either than a costly postage item as some of its critics contend. Helped as this is, the Alps does not no longer an over-riding deterrent even in conventional warfare. Although here they still separate a formidable obstacle.

One potential offensive factor for the Swiss would be the use of Soviet aircraft for an isolated strike against the southwestern French or Spain.

A look at a map of Western Europe shows there are relatively few places where they could place their planes for strikes at their own Switzerland in one.

This, again, is where the Alps can help, with their mountainous terrain (which makes that protect the air force), nuclear attack. One official explains:

"We don't know about fallout when we're under lock. We can even take off and land under such conditions with the expense time, but we're not before entering the risk would be very short."

To get in, he [the enemy] would have to use ground-based and, even if they did, they would be in the air and the aircraft would be lost to him. Not much would be left."

Lack of nuclear protection for its aircraft, which includes the Russian Su-26, and the Mark II Hawk based from Britain is a matter of great concern.

You can't have them at the front end of an air war, and the Rhodanese is a matter of fact. The entire unit is a war, it's about 80 tons. This is what we think on an defense with fighters is much more adaptable to the type of warfare."

Delivery of the Hawk would mean the air force's major appearance into the outside area. Their aircraft are self dependent upon fixed gun installations and trust of having its own for aerial warfare.

A number of U.S. and British air as



DN-112 VENOM is used primarily for close support of Swiss army units, but it also expected to have its own capability.

an aerial mission have been evaluated, however, and a final decision as to the type, or types, to order should be forthcoming within the next few weeks. U.S. forces include advanced and older, graded versions of the Hughes F-4s, recently evaluated by a Swiss mission in England, and an adaptation of the Douglas C-124, whose normal nuclear workload would not be available to the Swiss under present American restrictions.

Here again, the cost consciousness of the Swiss air force, which is a semi-autonomous division can play a final role in the decision.

The air force says it needs both radar and infrared sensors to be prepared to fight in any type of weather or atmospheric conditions. The army, on the other hand, that the Swiss air force is upon sufficient guidance for their air-to-air warfare, which is related alone in sufficient that a comprehensive radar system is too costly project.

"Certain radar can be provided," as in force official says, "but infrared can be substituted by artificial heat sources, etc. With the weather we live in Central Europe, we need both types."

Initial Mobilization

Equipment used, first and foremost task of the air force, and of the army, in the event of an immediate attack would be the initial mobilization.

Defied in the days when war was a slower moving thing, and still still a sufficient political warning is received the mobilization of the armed forces can be remarkable, rapid and not into reason. The problems of air-to-air warfare—without mobilization, there is substantially no armed force in being, as decreed by the Swiss constitution, it, must be ordered and in being.

by 6 p.m. on the day before the air and ground units are needed for actual defense.

If ordered before 6 p.m., the national defense force is alerted and scheduled for the transport of troops to their proper destinations. The national report to pre-arranged posts in time for the morning, in position and ready for action—whether in an underground bunker or a mountainous outpost hanging from an Alpine crag.

If ordered after 6 p.m., end of the normal working day in Switzerland classes are closed that the force will be ready to fight on the following day. The political warning to be effective, must come on time.

Enroute Time

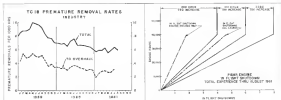
Time has elapsed up to the time the air force is alerted. "We have a sufficient time to control a possible move. But for an air force, one reaction time is too slow."

Another problem is that before mobilization a significant amount of the armed forces supplies, ammunition, spare parts, etc., are located in central rail line depots. This can put on a telephone book and find out where all that depots are, one or three miles away. The real danger for Switzerland is to be hit before we are not alerted."

Mobilization can be ordered—by the Swiss, during World War II—as a precaution, twice in times of danger. Under its neutrality status, however, the mere presence of masses of troops in its border or even a military violation of territory is enough to ground troops in mobile members are not allowed in sufficient reason for Switzerland to declare war, although the intention would be considered and possibly rejected.

A declaration of war would only be

MANAGEMENT



Premature removal of Calsit Wright Turbo Compressor engines is detailed at left; Ford & Whittier engines is detailed at right.

Airlines Refine Maintenance Management

By David H. Hoffman

More than 50 airlines currently are concentrating their technical attention on regulatory compliance and safety in an effort to reduce the \$500 million they spend each year on maintenance and controlling aircraft.

Also solving most of the safety and maintenance problems that cropped up during the transition to jet turboprop engines are taking a fresh look at the last two tools developed in more mature industries—electronic data processing, microprocessor analysis and quality and cost control systems.

But at the annual Air Transport Association Engineering & Maintenance Conference, it was apparent that the airline industry is nowhere near agreement on how these techniques should best be employed. Without hesitation in the past the carriers have passed their technical resources to speed development and design equipment from. However, the needed approach to problem-solving is far more difficult to apply in the management area because of widely varying maintenance practices, fleet

size, capital bases and seasonal traffic patterns. Engineers have tacitly agreed to a two-tier exchange of technical support—those of their own company in stacks of computer input cards and readout forms, airline representative charts and internal planning and auditing documents—they demonstrated that the goal of concentrating through standardization was a distant, if not unachievable objective.

There was not, for example, a single sign at the ATA forum that indicated the domestic carriers were moving toward joint purchasing of spare components, sharing of ground support equipment at major terminals or exchanging maintenance and overhaul functions in general. ATA's maintenance analysis subcommittee did develop a 50-page code identifying thousands of aircraft parts—nomenclature to system and location that could form the basis of a common data collection and computer analysis system if carrier future data files the subcommittee also stressed that it be distributed and further used for its service areas, making this project appear dead.

These last points detailing the status of maintenance and overhaul within the industry emerged from the numerous and formal reports of striking airline organizations here.

• **Standardized control systems** can have a great effect on the overall cost of maintenance and overhauling aircraft. Continental, for example, installed such a system 18 months ago for less than \$100,000. Since then, the total direct cost of its engineering and maintenance division has dropped 9.6% despite the fact that total work hours increased 16% and overhaul savings climbed 6%.

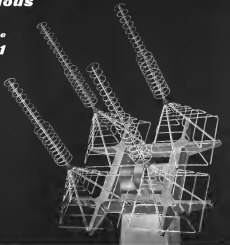
• **Aviation's backlog work** to reduce more and more engineering and maintenance functions to computer may be producing harmful side effects. Some airlines have found that administrative personnel savings are offset by the hiring of the new personnel needed to feed the computer increasing quantities of data. At the same time, collection of this data also hampers service changes at work and lowers labor productivity in the shop.

• **Jet fleet expansion** is forcing even the larger airlines to rethink the whole

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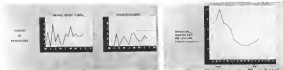
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*A representative type is model 2405 shown above.

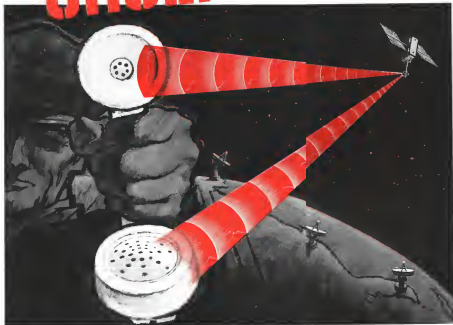
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CONVAIR 548 jet transport achieves reliability in indicated by its design compares favorably with all other civil jet transports and is significantly better than most piston planes (left). Conva 548 premature engine removal rate is at right.

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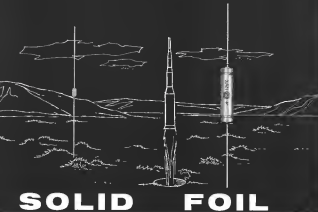
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* See Tech. note of General Electric Co.

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types of continuous maintenance system, which reduces the impact of work loads at extreme intervals from by spreading them over a series of periodic checks. Titan World Airlines, for example, plans to utilize overnight layovers for programmatic jet overhaul thus halving the time each aircraft is idled for overhaul during the owner's slack winter season.

High strength steels used in quantity on jet transports are facing the criteria to satisfy these inspection efforts and apply non-destructive testing techniques even to basic structures. Parts made of steels in the 100,000 to 100,000 psi heat treat range often fail completely if two surface cracks are not promptly detected and repaired. Defects as small as 0.01 in. should be spotted in the field, Boeing reports, for fatigue cracks and breaks have an extremely high propagation rate in high-strength steels.

Quality control in other manufacturing shops increasingly is being entrusted to line maintenance specialists rather than to independent inspectors. In the Aero Corp.'s new product category can be best maintained by "professional bodies" possessing good judgment and equipped with structural inspection tools. But these bodies, the owner adds, should be independently monitored while they "pay attention to the holes again."

Maintenance analysis, the "sawyer" with which industry attempts to pinpoint where extra labor and material are being expended, cannot fully develop until engineers decide on acceptable limits of component reliability. A "predictable state of evidence," according to Corbin Capital, indicates there is a definite correlation between the functioning or malfunctioning of a component or action on an aircraft and other components and other systems on the same aircraft.

In-flight failure and in-flight shutdown rates of the major airline fleet—Fleet & Webster's (F) and F) and General Electric's (GE)—will be declining. Scheduled test times between overhaul (TRCO), such as in the 2,000 hr. interval for the C119, is set at 16 months now, had an overhaul work program revised rate of 50 per 1,000 engine hours in 1970. This year, through August, comparable rate was 39 per 1,000 engine hours.

Continental Cost Control

Continental's cost control system, which the company calls simple and cheap, involves changing duty engineering and maintenance expenditure to a specific shop or work location. There are 22 of these "test centers" within the airline's engineering and maintenance division.

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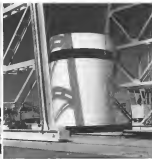
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The cost of miniaturization just dropped 20%

Trends can be overpowering. Once established, they're tough to reverse.

Take the cost of miniaturization, for example. As electronic packages get smaller, prices just get bigger. No one seems surprised. It's a trend.

There's a reason, of course. Tiny things are hard to build, especially with its space-age reliability requirements.

Amphenol designers decided that if even a trend needed reversing—it was due.

"Flow" was another question. They knew that conventional miniaturized pin and socket connectors were about as small as they were ever going to be. The spring mechanism in the female contact inherently took up valuable space and set a lower limit for practical center-to-center contact spacing. The spring was obviously holding up pins, not in miniaturization. It had to go.

So, it went.

Amphenol designers developed the Wire Form Pole House® contact, a male contact that supplies its own tension and can be crimped or welded before assembly. Overright contact spacing plunged from .175 inch to .100 inch. And, best of all, the new contact was less costly to manufacture (its built-in automatic equipment).

The trend reversal was well on its way. Amphenol designers had a new contact—the next step: putting it to work in connectors.

To answer the need for an economical micro-miniature rack and panel connector, the Micro-Rac was unveiled. Space-saving Wire-Form contacts and an integral-body-dielectric construction made it possible to pack 20% more connectors in the same space—and at nearly half the previous cost. As for reliability, after 1,000 repeated insertion and withdrawal cycles, the Micro-Rac retained its original low resistance characteristics.

Next came the Strip Connector, an inch lengths of Lexan® plastic with contact holes on .100 inch centers. A flash of your solder's delight, strips can be cut and stacked to suit hundreds of applications where a connector is a must—but for which no other economical connector exists. Example: strips can be stacked to form micro-miniature programming boards or instrumentation terminations. They also

• Amphenol 50 General Electric Co.



The Amphenol Wire-Form contact of work Multi-purpose Strip Connectors (A) shown in its Lexan housing (B) shown in its Lexan housing (B) shown in its Lexan housing (B).

can be used as economical type cable connectors, modular connectors, logic card connectors, to mention a few.

Wire-Form contacts can be used separately, too. Example: contacts can be crimped or welded to modules and plugged into special socket-type receptacles on printed circuit boards. Non-modular components such as transistors become plugable by crimping Wire-Form contacts to their leads.

And that was that. The trend was reversed.

If you would like more information about Wire-Form Pole House contacts, Micro-Rac and 104 contact rack and panel connectors, Strip Connector, or any Amphenol Connector for that matter, call your Amphenol Sales Engineer. Or, write to Dick Hall, Vice President, Marketing, Amphenol Connector Division, 1830 S. 54th Avenue, Chicago 50, Illinois.



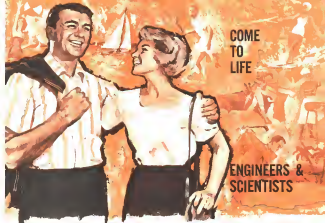
Adding the first spring design Wire-Form Amphenol copper base unit and wire makes a low resistance connection (0.005 to .0015 ohms) even after 1,000 insertion-withdrawal cycles.



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If the inquiry card has been received, or if you wish to furnish or request any detailed information, please write to Mr. R. M. Smith, Industrial Relations Administration-Engineering, Mail Zone 330-90 General Dynamics/Astronautics, 3705 Kearsy Pkwy Road, San Diego, CA 92161.



ASTRONAUTICS  **GUIDE**

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General Dynamics/Astronautics is located in San Diego, California, one of the fastest growing communities in the United States. It is situated 10 miles north of the Mexican border and a little over 100 miles south of Los Angeles.

Immediate openings exist in the following areas:

SCIENTISTS & ANALYTICAL ENGINEERS with Ph.D. or Sc. D. in electronics and physical research, computer analysis and applications, and instrumentation development.

ELECTRONIC DESIGN & TEST concentration on systems and data transmission design, logical concepts, automatic control systems, and electronic packaging. BS/EE plus appropriate experience required.

MECHANICAL DESIGN, ISME or AE for mechanisms, hydraulics, and fluid systems design and test. Also available GSE and machine structures designers.

RELIABILITY ENGINEERING: San Diego openings exist for experienced engineers with applied higher mathematics education on, preferably in statistics; higher degrees preferred. Current analyses with vibration and shock experience is also desirable.

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PRE-DESIGN ENGINEERS with experience in proposal preparation and system design of guidance and tracking systems.

If you desire to become part of this great team, we urge you prompt inquiry on the attached Professional Placement Inquiry.

Technical openings also exist in other divisions: *Write Mr. R. M. Smith, Industrial Relations Administration-Engineering, Dept. 135-99, General Dynamics/Astronautics, 5500 La Jolla Village Road, San Diego 12, California. (If you live in the New York area, it may be more convenient to contact Mr. T. Collins or Mr. E. Hart, General Dynamics/Astronautics, One Rockefeller Plaza, New York City, Telephone Circle 5-5034.)*

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R. G. Bortolotto of Pratt & Whitney reported that in 1968 his company's service overhaul group produced 1,445 overhaul reports based on 133,147 flight service representative reports and work plus "redletter notices." Data flow in 1961 promises to exceed these figures, Bortolotto said.

As of Aug. 31, Pratt & Whitney engine overhauls had logged almost five million hours of airframe service. Some turbojets, the turbojets in flight shutdowns rate per 10,000 engine hours for all issues has been 1.38. Engines entered in flight shutdowns per 10,000 engine hours averaged .951. Best engine also reported that.

• **Rapidly increasing TBOs** expose the average engine to an ever increasing "age." As the age increases, so does the size of in-flight shutdowns. The JT3C-6, for example, is that down almost three times more frequently at a time since overhaul of 1,500 hr. than at a time of 500 hr.

• **Cost of overhauling** all types of turbojets has proved to be substantially less than Pratt & Whitney predicted. Test Pratt & Whitney forecasts indicated that Pratt's average cost of overhaul could equal 5% of the engine's price, at second overhaul 10%, at third overhaul 12%. Actual costs, however, averaged 3 to 5% of engine price through fifth overhaul. In terms of dollar cost per engine, for example, this figure equaled about \$7,000 to \$8,000 without engine price credit.

• **Pratt & Whitney** has raised 2,500 engineering changes in its JT3C-6 engine since it received its FAA type certificate on June 19, 1957. Since the fall of 1958, the manufacturer published 41,452 manual pages of airframe, maintenance overhaul and receiver materials service bulletins and parts diagrams for its commercial jet engines.

CJ405 Overhaul Rate

General Electric, Pratt & Whitney's major competitor in engine turbojet sales, predicted that in CJ405-5 engines would run TBO averages at the rate of about 200 hr. per engine since every 90 days total overhaul time of about 2,000 to 2,500 hr. is allotted. The reason, according to GE, is the engine's in-flight shutdown rate which "has been better than three new four-engine jets." Highest airframe CJ405 TBO is 1,400 hr.

To satisfy FAA's Turbine Engine Time Control Program the CJ405-5 adjusted in-flight shutdown rate in 1960 was 18 per 1,000 engine hours. Rate in 1961 in this is about 10 per 1,000 engine hours, a figure which the engine has a 200 hr. TBO jump every six months.

During the first 16 months of airframe CJ405 operation some of the engines

periodically received required overhauls, all could be repaired, GE's T. J. Harris manager of maintenance and inspection engineering reported. Current 50% of more than one remount because of engine-caused mechanical moments have averaged less than 0.5% and flight cancellations about 0.3%, he said.

In a shop overhauling or least 20 engine per month, initial overhauls will average about 1,500 man hours, GE data indicate. When about 200 CJ405s have been overhauled, this figure should drop to 500-1,000 man hours, General Electric said.

CJ405 Overhaul Cost

First overhaul of a CJ405 according to GE will average \$7,500 per engine in parts. This equates a material cost per flight hour of about \$6.10 as a 1,300 hr. TBO engine, a cost that includes GE's original estimate.

Through Aug. 31, GE's Harris had reported 58 premature CJ405 overhauls. Engine faults that caused these can be divided into seven basic categories, GE reported, six of which cover two-thirds of the remounts.

Prevent problems with the powerplant after its introduction has been number one bearing failure combined with frame base distortion. Of the total engine remounts this was the cause of 13. Because the front frame of the CJ405 is a magnesium casting in proper or excessive use of the engine's air wing system or high airspeed, tire problems result in distortion and bearing failure.

However, GE states that an air-wing air temperature loading design, and other corrective changes, are being studied on operating engines to eliminate or minimize the problem. Failure of the first stage turbine shroud or air seal was the second leading cause of CJ405 premature remounts, reaching 15.

As a GE, GE developed a new basic overhaul type which is called a 10 all CJ405-5. According to GE spokesman, this problem has been "completely eliminated."

Third most frequent cause of CJ405 premature remounts, has been turbine bucket failure, which occurred in nine engines. Five affected the first stage turbine, four the third stage. Seven remounts were the result of a faulty tab welder in the inlet and transfer probe member. Failure of a weld joint on the vent tube for the ninth stage compressor air was traced in the cause of five remounts. Compressor case and back fractures caused four others, while 16 separate and miscellaneous remounts were traced to 15 premature remounts. For all, five have either been developed or are in process.

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Bell Helicopter Evaluating Rigid Rotor

By Ernie J. Bellini

Here, Tex-Bell Helicopter engineers have developed a rigid rotor to the point where they believe that one can enter in a range of maneuvering safely from small maneuvers to big ones.

Rigid rotor benefits also are applicable to tilt-rotor types of vertical lifters and landing vehicles the company reports.

Feeling here is that the rotor provides benefits so important that there is a "good chance" that the rigid rotor concept—when actually done back to power helicopter drive—could, in its own of form, replace present articulated helicopter systems.

Values Established

Bell's company financed test program, which has been infusing the current in a test since first full-scale flight tests here in 1957, has just about exhausted the capabilities of the standard Model 47 turboshaft engine to fly, but has definitely established the rigid rotor's past test values, leading Bell management to provide additional funding to build operational concepts that will more closely approximate actual performance that can be achieved.

Bell probably will start flying its automated rotor test rotor, Vice President Engineering, Burton Kelley, told Aviation Week. "I wish there for his study an attempt to match the

rotor and powerplant components against some performance because of having too much rotor for the power available. The three-blade rigid rotor test system comprised the addition of a standard 11-in.-diameter Bell 47 blade to a helicopter designed for a two-blade configuration. The advanced rotor will rotate three right-angled blades of thinner airfoil section, plus cleanup of ribbing hardware and other components, providing a marked solution in design.

NASA Interest

National Aeronautics and Space Administration also has contracted with Bell to supply an integrated rigid rotor system and set of blades to its Langley Laboratory so that the agency can conduct an independent evaluation program.

Since the rigid rotor is such a basic approach to the helicopter rotor design problem, it undoubtedly has been as much studied in all of the major rotor forums, plus would other designers in the field. Among contemporary programs the Lockheed helicopter test vehicle (AW July 31, pp. 26-27) has been the only one to grant public review. Indications are that the Navy's interest in this development has opened Bell to discuss its long-term research in the same field.

The rigid rotor is an evolutionary breakthrough—an engine close to the program continues that because of its

rotor, there can be little reasoning that it will be profitable. Because of its basic simplicity, it was used on several of the rotor helicopter projects at the time of the tests. Kelley is, however, not as sure as others that the rigid rotor system. Nevertheless, he said development of the rotor could be used in the articulated rotor and, as a result, the rotor of the helicopter itself, could be used as a development from this rotor, leading to the complex systems in use today.

Several post-World War II examples of rigid rotor use can be found—the Lockheed two-rotor design, for example, with a more recent specimen being the rotor profile of the tilt-wing V-63.

System's Layout

The rotor, single post, rigid rotor, the rotor hub to the main shaft, is the conventional, fixed-wing, aircraft's propeller is attached to its hub, with the two blades being in the rotor blade pitch change mechanism.

What does markedly differ Bell's own combined rotor system—generally termed a "semi-rigid" system—is that Bell mounts its hub on a gearbox, permitting the rotor to tilt at an angle for cyclic pitch, being rigid in collective pitch. In the rigid rotor system this independent tilting of the rotor is effectively locked out. Part and parcel of the rigid rotor is locking the blades to the hub shaft hinges, developing fixed rotor

system designs in the rotor, except for the negligible amount of flexibility in blade flapping due to the limits imposed by practical construction techniques where weight limitations would actually require minor improvements possible by supporting structures. In fact, some blade flapping flexibility probably is desirable as a means of relieving some of the stresses imposed by loading moments directly onto the post.

In practice, helicopters of the size of the Model 47 probably could have blades built with a high degree of stiffness before the structural weight rotor would become prohibitive, Kelley believes. Much larger machines developing higher than loads would naturally require more flexibility to relieve these, and blades of these size would require an exceedingly heavy structure anyway.

Of major importance in the rotor is hub design and blade-to-hub rigidity.

Key benefits of the rigid rotor system achieved by Bell engineers include the following:

- **Appreciably reduced rotor-to-gearing travel for the single rotor helicopter configuration, with indications that the maintenance loading capabilities will be available over the entire mission envelope.** Kelley believes this greatly decreased this characteristic of the rigid rotor machine when, during a flight test of the current development vehicle, it was hoisted clear to the ground and be pushed up and against the tailboom considerably off of the rotor station.
- **The pilot reported that only a slight stick movement was necessary to compensate for the weight variations.** The same characteristic that makes the rigid rotor an attractive to the single rotor helicopter weighs against its use in tandem configurations, engine-out, area variation of cyclic pitch, in this configuration would introduce opening moments into tandem rotors that would tend to conflict with each other.
- **Reduction of rotor complexity by reducing the number of parts needed per blade, particularly bearings, in all drives to reduction of components in hub system.** Bell estimates that characteristic of bearings in the rigid rotor, aside from those needed for blade pitch change, would reduce be about half those required in its own external and rigid Model 47 rotor system and could mean a reduction of up to five-thirds the number needed to offset rotor losses. It is this reduced complexity of parts, maintenance time and skills required that particularly attracted the interest of Navy in the Lockheed aircraft.

Aerial weight savings in conventional rotors, possibly would be negligible, Bell believes, since the principle of rigid rotor operation, part load and one would displace into the rotor and transmission and some strengthening of



RIGID ROTOR HERE providing a high degree of stiffness in system is shown in shop tests. Tail rotor shaft is being inspected by Bell engineers Fred Wagner (left) and Wally Cook. Vertical linkage system only provides blade action for pitch change angle.

these components probably would be necessary. However, that is not a normal consideration and one could hardly eliminate the secure fitting of the rotor particularly in low speed, small helicopters, would allow percent to approach and have the rotor while the rotor is turning slowly a short time of disengagement. Blade stop action, not available to prevent these rotor from striking the structure, also could be eliminated.

• **Markedly improved handling qualities** will be provided the pilot due to rigid rotor response to stick motion provided by the rigid rotor, which feeds blade tilt movements directly and rapidly into the mast. This characteristic would reduce a common tendency that can be recognized by lag of control stick and unsteady rotor. Although flight stability may not be one of the objects of rigid rotor research, another indication that a rigid rotor would be stable with

out the use of rotating masses, given an actual control system. The further, though, aerodynamically deficient because of its rotor, evidence, has shown a marked degree of inherent stability, particularly in landing, Kelley notes, that appears to be no greater or better than the standard Model 47 fitted with a stabilizer bar.

The combination of inherently good stability, combined with rigid rotor control, provides desired landing advantages for the rigid rotor system, since often in the past having stability has been given at the sacrifice of maneuverability and vice versa.

To further investigate these characteristics, Bell had pilots of varying degrees of experience in the field, including beginning General contractors of general use that the Wind Tunnel work, some form of stability assessment probably would be required, because for this type of work, the rigid rotor is considered



INCREASED CENTER OF GRAVITY made possible by use of rigid rotor system shown installed on a Model 47 rotor, in dense climb (left) is Bell Helicopter Co. Vice President Engineering Burton Kelley. Flight characteristics of three-blade rotor with high degree of rigidity were tested by Bell engineers using electric motor-powered model (right) in early 1960.





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RM-3	11.1 x 1.0	1.0 x 1.0	100 lb
RM-4	11.1 x 1.0	1.0 x 1.0	100 lb
RM-5	11.1 x 1.0	1.0 x 1.0	100 lb
RM-6	11.1 x 1.0	1.0 x 1.0	100 lb
RM-7	11.1 x 1.0	1.0 x 1.0	100 lb
RM-8	11.1 x 1.0	1.0 x 1.0	100 lb
RM-9	11.1 x 1.0	1.0 x 1.0	100 lb
RM-10	11.1 x 1.0	1.0 x 1.0	100 lb

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posed a great asset in the form of stabilization.

The company's early approach to the rigid rotor was to start from the "soft" end of the spectrum and work toward extreme rigidity in both hub-to-rotor and blade attachment. Initial effort was to modify a ground-mounted (two-blade) rotor, installing most essential springs to meet rotor flapping stresses and introduce a bending moment into the rotor.

Soon afterward the company designed and built a "flexible" rotor, in which each blade was individually secured to the rotor using a flexible steel member, which was rigid elsewhere but permitted restrained blade flapping. That notion differed from the earlier non-resistant spring configuration where the blades were not directed individually and indication of the cause three-blade rotor caused deflection of the springs. The flex-horn rotor eliminated all bearings except those used for blade pitch change.

The flex-horn system was flight-tested successfully throughout 1953 and encouraged the company to study the possibilities of going to maximum rigidity in the rotor system. Concomitantly with analytical work, a model program was initiated to investigate possible dynamic problems and indicated that a high degree of rigidity was entirely feasible.

Blade Flexibility

Bliffl studies on blade flexibility have moved the rotor system from a point where the blade mounting was so "soft" that the tips would touch, touch the tail except for bearing, to the highest degree of rigidity practical, satisfactory with models, and in full scale.

Bliffl asserts that Bliffl engineers now know a lot about blade flexibilities and rotor spin are desirable for the entire fuselage spectrum of single rotor between 100 and 1000 rpm. Actual flight testing of a variety of flexible configurations will be added to incorporating a variable rigidity into the performance optimized test vehicle so that this study can be carried on with a minimum of downtime.

Flapping flexibility of blades introduced some complications in rotor dynamics analysis, Bliffl admits. The rigid rotor acts as a gyroscope mass and the small angle whirling upon blades into two spins. Flexibility introduces periodic coefficients that digital computer analysis makes more complex. The introduction of a small amount of flexibility at the hub greatly improves the rotor out of the analytical work in data, has kept pace with flight testing and that the project has encountered no unusual problems and that there have been no blade failures with the three-blade rigid rotor system.

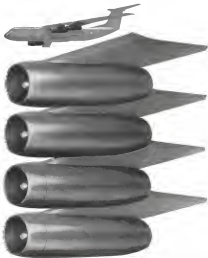
A two-blade rigid rotor system gives



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a more formidable problem: one of mechanical dynamics, rather than aerodynamics, that is only recently beginning to be appreciated. Basically, a two-blade rotor rotor has more inertia about a vertical plane, but not a vertical axis. On rotation, non-cylindrical gyroscopes are quickly developed that transfer to the rotor used in the form of violent shudder and rotation that become uncontrollable. Experimental work by Professor P. J. Rousset and S. H. Gossard of Massachusetts Institute of Technology, investigating this basic phenomenon, points to a research team with a small non-aerodynamic rotor has been much study showing up this complex problem and the lack of knowledge of the dynamics involved.

Roll engines, in the course of their studies, evaluated a full-scale two-blade rotor on a test down Model 47 helicopter, which made one staff apart as less than five revolutions from start of blade rotation, while still at half speed of about 150 rpm.

PRODUCTION BRIEFING

Northrup Corp. has received a letter contract from USAF for approximately \$64 million for an additional 144 T-35A supersonic jet trainers, with initial funding of \$20 million. Production rate will reach 12 aircraft per month in December, the new aircraft will be produced between December, 1962, and November, 1963.

Lockheed PV-4 Orion attack aircraft modification project has completed two weeks of Super performance evaluation tests including combat-type takeoffs. Four delivery to fleet units is scheduled for mid 1962.

Automotive Division of North American Aviation, Inc., has received a contract, \$17.5 million in contracts from International Business Machines Corp. for termomodern computers, test controls and auxiliary equipment for Air Force B-52 bombers.

Hydra-Air Co., Bedford, Calif., will supply main and nose wheel landing gear with skid systems for Boeing 727 jetliner under a \$540,000 contract.

Deere Harvester Ltd., has been licensed as a subsidiary of Wilbur Owen and Son, British shipbuilding firm, to build the Deere Harvester vessel (AW Oct. 14, p. 186).

Low, Inc.'s Lear-Barter Division, Lima, Ohio, will supply fuel boost pumps for USAF's B-57B under contracts totaling \$27,845 from Boeing.



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Lunar Radioisotope Generator Detailed

By Barry Miller

Las Vegas, Nev.—A Radioisotope-fueled thermoelectric generator capable of providing up to 25 electrical watts over a four-month period on the moon's surface to power instruments and electronic equipment aboard the nation's first manned series of crewed landed lunar spacecraft (Gemini) was described here during the recent International Symposium on Atomic Space Nuclear Propulsion.

The generator, which employs the heat of a radioisotope, cannot rely on the energy source for a thermoelectric conversion system, was designed by North Division of the Martin Co. in consultation with Hughes Aircraft Co. The latter is prime contractor for National Aeronautics and Space Administration's Surveyor soft, or uncrewed, landed spacecraft.

As outlined in a report by engineers from Martin, the precise generator concept is regarded as a reference design for a flight version which Martin would probably be asked to build if NASA and the Atomic Energy Commission approve the use of a radioisotope-fueled generator for Surveyor. The Surveyor program director has believed for a number of years that the use of a more conventional solar cell and storage battery power supply for technical systems but these choices could be finally overruled by the political authorities whose approval had to be secured before the Navy was able to attempt to adapt a smaller, 2.7 watt, Martin-made plutonium-238 radioisotope generator now successfully powering its Transit-4A satellites.

Regardless of that meeting, it was reported that the State Department had not received the radioactive foreign substance it feared to the adding of a radioactive device in space. On the other hand, having a radioisotope generator on the moon, some scientists, or, perhaps a possibility, no matter how remote or how thorough the precautions, of interfering through unknown or erroneous communication with scientific exploration of the moon.

Canon 242, which is obtained by extreme resolution of americium-243, was selected for a variety of reasons, explains Alvin J. Strub, who presented the paper just prepared by him, Robert J. Wilson and Thomas S. Eustice. The isotope and its daughter, plutonium-239, are primarily alpha

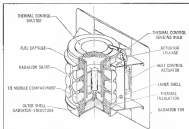
emitters and would not add to the moon's environment that was already there. Hence, these are essentially safe, if elements their presence on the moon could be discovered in future scientific investigations.

The atomic generator, including shielding, would weigh about 10 lb. and could provide about 18 watts during the lunar day, an output that would rise to about 25 watts during the lunar night because the cold junction temperature of the thermocouples would be lower than during daytime. The

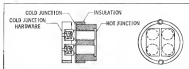
generator was designed primarily for nighttime operation.

Ability of this radioisotope generator to operate during the 14 earth day lunar nights is one of its principal advantages over a solar cell system which would have to convert sufficient solar energy while facing the sun to charge batteries for lunar nighttime operation.

Another prime advantage is its simplicity: use as a thermal electronic converter. Waste heat of the radioisotope generator can be utilized into the thermocouple package of Surveyor instruments



RADIOISOTOPE THERMOELECTRIC GENERATOR, designed to provide up to 25 watts of electrical power for instruments and electronic gear on the Surveyor unmanned lunar vehicle. Plutonium fuel capsule containing a small amount of americium-243 at its heat source for two parallel banks of four thermocouples. Generator would weigh about 10 lb. and will deliver the 18 to 25 w. long scheduled and dependent above, which, stored for a 15 to 17 w. output for cold periods but for another electronic equipment during the long lunar nighttime periods. Thermoelectric modules of the Surveyor generator (above) contain two pairs of thermocouples with hot and cold ends preheated to zero point. The two pairs in a disk of constant metal are the module. During the lunar night, when the cold junctions are at lower temperatures than during the day, the unit would produce 25 watts compared with 18 during the day.



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to protect them from the cold hard exterior. Outer night-time temperatures range down to roughly -240°F.

Heat has radiated into the electronics package will be controlled by a thermal shield at center of known resistance according to the temperature of the package. Such was the heat, the package required about 100 thermal watts while during the day this requirement triples and the shield is closed so that no heat is lost.

The generator shell is cylindrical in shape, roughly two inches long and eight inches in diameter, and contains within it a smaller container with cover 3/4". The container is attached by tapered fins to a 1/2" in square aluminum surface to be used for temperature control.

Heat produced in the radioisotope source flows through the heat source assembly in which it is enclosed and is radiated to the outer shell, according to Smith. Heat then is conducted through the thermocouples and is relative to the outer generator surface which radiates it into space. Electrical power is produced by the Seebeck effect as the heat flows through the thermocouples.

To offset a possible dropoff in power output from the device, the radioisotope production decays over its 120-day lifetime, the radioisotope assembly is deliberately overbuilt. Smith explains, and the extra heat dissipated by a high-temperature radiator over the first days of its life. The rate at which heat is dropped throughout generator life, he adds, is controlled by positioning a shutter door covering the high-temperature radiator in accordance with the lifetime of the thermocouple's hot junction.

The surface of the generator, not including the shutter, is coated with a high-temperature oxide with high emissivity in the infrared and a low absorptivity with respect to solar radiation.

As made with the combination of these two characteristics, the efficiency of the generator is expected to be 4.4% while the efficiency of the thermoelectric conversion will be at least 5.5% and 4.5% during the day.

In nighttime operation, a small efficiency of the generator is expected to be 4.4% while the efficiency of the thermoelectric conversion will be at least 5.5% and 4.5% during the day. Maximum heat input to the thermocouples is 400 watts. Available 57.5 watts could be stored in the battery. Under losses. Figuring a total heat requirement of 57.5 watts mechanical operation and about 25 watts output gives overall system efficiency of 4.6%. Maximum heat potential is 5.27 watts. The 21 watts available should be sufficient for Saveron instruments (AW July 3, p. 62) provided

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Flight Propulsion NEWS

A report on progress in research and products from the Flight Propulsion Division of the General Electric Company

McDonnell F4H Breaks World 3-km Speed Mark

WHITTS SANDS, N. M.—The U.S. Navy's McDonnell F4H Phantom II collected its fourth major flight record late when it smashed the world three kilometer speed mark.

Flying below an altitude of 100 kilometers (328 feet), the G-E J79-powered fighter streaked across the 3.1 mile course at an average of 502.768 miles an hour, 3 surpassed the previous record, set by a USN Douglas XF4D in 1962, by nearly 150 mph.

The McDonnell F4H made its debut as a world recordholder roughly a year ago when it broke two Russian-held three-kilometer speed marks. In early September, 1960, the F4H circled a 500-kilometer closed course at 5216.79 mph. A few weeks later it logged 139,821 over a 100-km closed course.



Navy F4H flies low during record 3-km run

J79 DOMINATES SPEED RECORDS

CINCINNATI, Ohio—Of the new world speed records, only 1600 miles-per-hour currently recognized by the Federation Aeronautique Internationale, eight are accounted for by U.S. aircraft powered by the General Electric J79 engine.

Three fourths of these are held by the USN's Carrier Battle Hunter, which ended up as world best January over 1000- and 2000-kilometer closed courses. Top speed logged by the Hunter was 1364 mph.

The remaining two speed marks—1500- and 1000-kilometer speed—were set by the USN's F-4H Phantom II.

These two aircraft, together with the G-E powered Navy North American A-1J and Air Force Lockheed F-104, have held 19 of the 42 world jet aircraft altitude, speed, and time-to-climb records recognized by the FAI.



G-E powered Pucelle-Douglas executive jet is used for flight test in 1962.

CJ610 Engine Chosen for New PD-808 Jet

LYNN, Mass.—The General Electric CJ610 turboprop engine has been selected to power the new Pucelle-Douglas PD-808 executive jet aircraft.

The PD-808 marks the third executive jet application of the CJ610 to be announced this year.

The new jet, designed by Douglas Aircraft Company and to be built by Pucelle Company of Italy, is scheduled for flight test late next year. Intended primarily as a business-class craft, it may also be equipped as a high-density, 70-place transport, or as a deluxe step-ladder executive plane.

Under arrangement with Pucelle, Douglas plans to sell and service the 800-hp engine throughout most of the world starting in 1963.

The CJ610-1 engine selected for the PD-808 develops 3880 pounds of thrust. Only 40 inches long and weighing 355 pounds, it produces more power for its size and weight than any other turboprop powered available today. Earlier versions, the CJ610-2B, push over 3500 pounds of thrust.

Both models of the CJ610 will be FAA certified this year. It is already in high volume production in the military J28 turbojet, which powers the Air Force's Northrop F-5B supersonic trainer, the Northrop M-55 Freedom Fighter, the McDonnell G-4M-75 demomobile, the McDonnell G-4B supersonic target drone, and the NASA X-15A VTOL demonstrator.

High performance of the CJ610-1 permits use in business aircraft such as the PD-808 to take-off and land on the same fields as those used by prop-driven aircraft.



T64 Turbines to Power Tri-Service Transport

LYNN, Mass.—The Tri-service VTOL transport, to be built by the team of Ling-Temco-Vought, WPA, Aeronautical Co., and Hiller Aircraft Corp., will be powered by General Electric T64 gas turbine engines.

The new aircraft is intended for rapid all-weather transport of combat troops, equipment, and supplies from aerial, short or surfside into expeditionary areas.

Four G-E T64-5 engines, mounted as a dual unit, will drive four conventional U-500 propellers and a horizontally mounted jet rotor through an intermeshing gear train and shaft. The aircraft will have a cruising speed of 210-230 knots, with a top speed of 400 knots at sea level. Its combat radius, while carrying 35 fully equipped combat troops or equipment, will be from 200 to 300 nautical miles. Fitted with auxiliary fuel tanks, it will have a ferry range of up to 2500 nautical miles without cargo.

TWA Orders 20 G-E Aft-turbopan powered Caravelles



TWA order will identify the new aft-turbopan powered Caravelle 10A when 20 of the advanced medium-range jetliners start domestic service beginning in 1963.

NEW YORK, N. Y.—Twenty Sud/Airbus Caravelle jetliners have been ordered by Trans World Airlines for service starting in early 1963. It was announced recently by TWA president Charles C. Tillinghast. The 20-caravelle order also included an option for 10 more of the same type.

To be known as "Le Nouveau Caravelle," the model 10A aircraft selected by TWA has modifications that make it the fastest, most advanced of the famed Sud Caravelle series.

Power for the new Caravelle will come from two General Electric J79-25C-2-11 turbofan-propellers that will provide the jetliner with better efficiency, lower noise levels, and increased climb and cruise thrust.

First delivery of the TWA Caravelle fleet is scheduled for January of 1963, with completion of the order by July.

Airframe modifications on "Le Nouveau Caravelle" include an increase in passenger capacity (56 first class seats as opposed to 54, seating to 85 tourist seats), and wing configuration changes that permit greater speed capabilities.

And American's modifications changes included, with G-E turbofans in place, will give the Caravelle 10A improvements in both range and speed.

Increased climb thrust of the aft-turbopan engine will enable the Caravelle to reach an altitude of 35,000 feet in 18 minutes at full gross weight.

The new Caravelles at an average TWA trip distance will operate from 3500-foot runways, which will enable TWA to allow jet service over a greater portion of its route structure. Operating range will be about 1460 miles, and top cruising speed around 580 miles an hour.

Extensive flight test experience has already demonstrated performance of the G-E J79-25C-2 engine. During a recent European demonstration tour of the G-E Caravelle, there were no delays or cancellations during scheduled flights. Over 100 airports in 11 countries.

T64-powered Caribou Makes 1st Flight

DOWNSVIEW, Ontario—Flight testing of General Electric's T64 turboprop engine began here on September 22 aboard a modified 209C-4 Caribou flying test bed.

The current prop only in flight testing of the Caribou with T64-4 engine is scheduled for completion early next year. The T64's maiden flight in full-scale testing Downsvier plane lasted more than an hour. Altitudes ranged between 4800 and 12,000 feet.

The flight test program is being conducted by General Electric and developed under sponsorship of the US Navy, for whom the engine is being developed, and with the cooperation of the Canadian Department of Defense Production and the RCAF.

The T64 engine, designed for a variety of applications including V-22, helicopter and conventional aircraft, is the first American gas turbine that operates with the low fuel consumption of a reciprocating engine. It can be operated continuously at angles less than 180 degrees and as up to 45 degrees nose down, and has four configurations—two turboprop, a turboshaft, and a direct drive version.

Development of the T64 began in 1957. Up to the start of the current flight test program the engine had accumulated more than 8000 hours of development test time.

The conventional piston-powered Caribou, an OTOL troop or cargo transport capable of operating from rugged battlefield areas, is currently in service with the U.S. Army, the Royal Canadian Air Force, West German and the United Nations.



Caribou climbs in first T64 test flight

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For free brochures on the G-E engines and propellers options discussed above, just check below and send coupon to General Electric, Section A-236-03, Schenectady, N. Y.

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<input type="checkbox"/> GED-4338 "The T64 engine"	NAME _____
<input type="checkbox"/> GED-4451 "The CJ610 engine"	TITLE _____
<input type="checkbox"/> GED-4106 "The T64/OTV"	COMPANY _____
<input type="checkbox"/> GED-4114 "J79 powered Caravelles"	ADDRESS _____

GENERAL ELECTRIC

12 Rescued From Burning Plane Before 100,000 Spectators



THREE PERSONS WERE KILLED, 12 others injured, when the Air Force transport crashed during a recent air show at Wurtsmith. The Kaman H-43B helicopter, left, maintained its position as the helicopter dove.

QUICK THINKING AND COURAGE OF OFF-DUTY HUSKIE RESCUE TEAM PREVENTS FURTHER TRAGEDY

WILMINGTON, N. C.

The dramatic rescue of 12 men from a burning C-124 transport which crashed before 100,000 horrified spectators at an air show in Wilmington, N. C., Sept. 20, 1971, has been credited to the courage and skill of an H-43B KAMAN helicopter crew. The H-43B KAMAN helicopter crew landed in the woods near the crash site, where the plane was on fire. The helicopter crew then flew to the crash site and rescued the 12 men. The helicopter crew then flew to the crash site and rescued the 12 men.

Steno, both crash rescue specialists, and Capt. Charles Fawcett, flight surgeon. When the crash occurred, the H-43B crew was coming out of the show. Within ten minutes the crew had reached the helicopter out of the display area and were on the way to the crash site. The helicopter crew then flew to the crash site and rescued the 12 men. The helicopter crew then flew to the crash site and rescued the 12 men.

The Kaman H-43B HUSKIE from Haverhill, Mass., Air Force Base, N. C., was assigned to the air show for a static display. It was not an duty for crash emergencies. One of the helicopter was Capt. J. C. Armstrong, Air Force, and Charles Fawcett, co-pilot, flight surgeon. H. Holman and AIC Gene

Woods could blow the flames away from the cabin. Officials said the helicopter rescued only three persons injured, to the hospital. At 10:20, military personnel and civilian men a fire-fighting truck.

Photo by — Duff Morgan WOOD-TV

Steno, both crash rescue specialists, and Capt. Charles Fawcett, flight surgeon. When the crash occurred, the H-43B crew was coming out of the show. Within ten minutes the crew had reached the helicopter out of the display area and were on the way to the crash site. The helicopter crew then flew to the crash site and rescued the 12 men. The helicopter crew then flew to the crash site and rescued the 12 men.

Rescue personnel worked for 15 minutes before victims were rescued from the wreckage. The helicopter crew then flew to the crash site and rescued the 12 men. The helicopter crew then flew to the crash site and rescued the 12 men.

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equipment and communications are separately rather than simultaneously separated.

If the generator were to be built today, it would use lead sulfide thermocouples which are among the best semiconductor available for thermoelectric power conversion. The Sarnow generator design employs 35 couples in two parallel banks with heat sources around the best source. Each bank can produce 12.5 watts. T and N elements will each be 5 in. long with diameters of 3.365 and 0.533 in. respectively. Such size that approximately 1000 couples would be required to generate 1000 watts. Such size that approximately 1000 couples would be required to generate 1000 watts.

Both thermocouples, inside will operate simultaneously to supply a load and to prevent adverse temperature gradients in the generator. Such size.

Thermocouples are packaged at both hot and cold junctions to resist shock and vibration. They are placed in a disk of insulation to make up a thermocouple module.

Generator Advantages

Advantages cited for a radioisotope generator include:

- Reliability—Redundant design of sub-units within the generator and the absence of moving parts within the conversion system (thermocouples) are considered to combine to give high overall reliability.
- Neutral power—System provides power at relatively high efficiency during daylight periods when it has the most advantage over a solar cell system which tends to be heavily loaded toward the sun and which needs shade between to supply power during night.
- Insensitivity to heat—Thermocouples—Radioisotope system is relatively insensitive to sharp day-to-night changes in heat environment without output changing too appreciably. Since the radioisotope system is operated for maximum efficiency it would be implemented by a solar cell panel for additional electric power.

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are not going to change our ways. Our customers like it that way, and we have gone to some trouble for 21 years to make precision a precise habit at TACTAIR. This applies to both special and standard valves. Here are two examples:



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The powerful TUM-12 telemetry antenna now in service at the Air Force Missile Center, Cape Canaveral, Fla., is used for the automatic tracking of missiles and earth satellites. This huge "enormous net," specifically designed by Radiation, Inc., Melbourne, Fla., has an effective data reception range of over 1000 miles.

One of the key parts of this highly sensitive device is the 3/4" 30 ohm aluminum shielded Styroflex® coaxial cable that links the 60-foot parabolic reflector to the receiver. The task of carrying missile-to-earth signals from the antenna to the control building demands a low-loss, high frequency cable with a high signal to noise ratio.

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Advances in Avionic Devices Reported

By Philip J. Klaus

Washington—Advances in vacuum diode tubes, micro-electronics, power tubes, tracking and display devices were reported last evening at the recent Annual Electron Devices Meeting sponsored by the Institute of Radio Engineers.

• **Micro-wave triodes**, capable of operating at frequencies above 2,000 mc, were reported by Harold Sussman and Corp. and Bell Telephone Laboratories recently. General Electric's double-dielectric vacuum plane N-P N-tube has exhibited gains as high as 14 db at 2 line and have operated at 2.4 line with oscillator output power of 40 watts at 1.5 line. The report was jointly authored by D. T. Olson, Owen Baker and G. E. Moore. Bell Telephone Laboratories' J. T. Nelson and A. G. East reported performance of a single triode amplifier using a diffusion-base germanium device which provided 33 db gain at a carrier frequency of 1.5 line with a 5 db bandwidth of 300 mc.

• **Triode semiconductor high Q tubes** for using a germanium triatomic wave induction can be used by changing its bias, resistance and collector capacitance, has been demonstrated by Hughes Aircraft Company. Technology is reported to prove useful in micro-electronic semiconductor circuitry in devices ranging from few volts between at frequencies of several hundred kilohertz to 1 line at 100 cps has been obtained it was reported. The report was jointly authored by Charles L. Hines and Walter Watson.

• **Triode semiconductor diode**, low loss in which the delay increment can be varied by changing the voltage applied to the device was reported by John S. Wernim, of Electro-Optical Systems, Inc. The diode has consists of a germanium bar approximately 0.1 x 0.1 x 1.0 cm long which is tapered and each top face is mounted, mounting network. Electrode is obtained by means of voltage applied across diode contacts at each end of the bar. In operation a periodic signal applied to the device whose period is equal to the delay increment, structure taps, produces a resonant signal output from the resonant network, while signals at other frequencies are not amplified as much. In a typical unit, center frequency can be changed from 15 kc to 50 kc by changing applied voltage from 10 to 25 volts. Pass bandwidth is one-third of center frequency and power gain is greater than one, variation and.

• **Semiconductor impedance** transformers, a new type device fabricated on

a single silicon crystal which can be used to transform from high to low impedance levels with power gain of 40 db over a limited frequency range, was reported by Karl Yeh and Larry Polak of Westinghouse Electric. Patent design provides overall transmission of 5,000 to 10,000 volt and open circuit voltage gain greater than 20.

• **Radiation resistant solar cells** fabricated from gallium arsenide which have exhibited conversion efficiencies up to 17%, were reported by N. T. Lewis of Radio Corporation of America. This is the highest conversion efficiency yet reported for gallium arsenide and solar cell death competitive with silicon. The report was authored with D. P. Bortfield, A. R. Cohen and G. W. Melby. Bell Telephone Laboratories recently reported the development of N-P type silicon solar cells with No. 6 diffusion base thickness of 1 to 1.5 microns making them radiation resistant and sensitive to solar energy in the 0.4 to 0.7 micron region. Although the new N-P cell has lower initial conversion efficiency than a conventional P-N cell, it can deliver far more power than a conventional cell after both have been subjected to radiation, RFA research reported. The report was jointly authored by K. D. Smith, W. G. Ansel, D. J. Corbelli and M. P. Legault.

Development in power tubes is reported at the Annual Electron Devices Meeting included the following:

• **Cosmofield amplifiers**, a new type of forward wave amplifier with some

constant beam and wave, called the Deuterium, which has demonstrated pulsed power output of 500 kw at X-band 11 db gain 13V beamwidth and 17% efficiency, was reported by L. H. Indurata, captain, J. F. Pringle, Mrs. E. Kishner, and Joseph F. Heff. New tube is the first to exhibit gain above 4 db in a distributed constant cosmofield amplifier without using separate feedback of a second electron beam, permitting far greater modulated bandwidth than the other two.

• **Small tracking wave tubes**, developed for use as communication gateways and other space vehicle communications applications, were reported by three companies. Sperry Gyroscope's Jerome Korman described a tracking wave tube for operation at frequency of 1 to 12 line with continuous-wave output of 10 to 40 watts, which weighs only one pound including housing against a report by J. N. Nelson and L. A. Roberts of Westinghouse Co., described a traveling wave tube with power output above 32 watts in the 2.0 to 2.4 line band. Tube has overall efficiency including heater power of 27.4 at band center and provides more than 70 db insertion gain. Weight of completed tube, including housing, permanent magnet is 1.1 lb. Bell Telephone Laboratories' M. G. Rudenok described a traveling wave tube designed to operate at less than 70 watts with overall efficiency of 31% and a regulated heater that consumes about 15 watts.

• **High-power tracking wave tube**, a



HIGH-POWER X-band amplifier, developed by SFD Laboratories, delivers 10 megawatts peak power 70 watts average with very high gain stability. Traveler version of new amplifier with one megawatt output is under development.



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HIGH-POWER TWT A 100-watt magnetron was designed to fit in a 140-lb tube with 80% bandwidth at 3 kHz. Tube developed in Sperry is called "Merendino" because of cooled tube which conducts in pulsed and cross liquid cooled. Tube shows in two sections, is 4 ft long.

periodic tracking wave amplifier capable of producing up to 100-lb peak power output at 3000, with a small signal gain of 12 to 40 db and a sensitive gain of 20 db over the bandwidth of 2.85 to 3.2 kHz, was described in a report by R. A. Haglund and A. L. Reardon of Hughes Aircraft's Merendino Tube Division. Weight of the tube, including permanent heating magnet, is 90 lb and its overall length is 31 in.

High-power Liquid Helium, a four-inch tube which produces more than 100 megawatts peak and 100 kilowatts average power for pulse lengths of more than 100 microseconds, was reported by R. L. Holaday and G. W. Pincus of Texas Instruments. Tube operates at a 10% duty cycle, producing a peak power gain in excess of 40 db. Tube has phase-invariant characteristics which permit use of limited pulse complex wave.

Ultra-high-power X-band magnetron, a type known as the CEM Central Magnetron, which has delivered 31 megawatts peak power 750 watts average, and weighs only 45 lb, making it suitable for carrying airborne radar, was reported by Fred Vondra of SRI Laboratories, Davis, N.J. (Report was jointly authored by Jerome Dwyer and Alfred Clark). Further said the frequency stability of the new type, using action is four times better than conventional type. A humble version of the CEM magnetron, now under development, has produced a maximum of one megawatt peak power when tested in excess 8.5 and 9.1 line. It was reported with no discontinuities throughout the range. Five water cooling surge is expected.

Ultra-high power tracking wave tube which produces one megawatt output over a 50% bandwidth at 3000, using

beamless open interaction structure called a magnified Merendino, was described by Carl Baillard of Sperry Gyroscope Co. Tube is made to be between 2.5 and 5.45 kHz, producing 1.25 megawatts at center frequency with efficiency of 10%. Tube design is expected to permit outputs of several megawatts. A cooled tubing performs dual function of conducting signal and cooling electron beam.

Display and Switching

Designs in display and switching techniques reported at the Annual Electron Device Meeting included the following:

High density cathode ray tube, with electron gun capable of producing a spot with a diameter of only eight microns, equivalent to a display of 92 million dots on a 5 in. tube face, was reported by Dr. Kurt Schluenger of General Electric Co., Research, N.Y. The smallest tube can scan a square of 4 in. at 9000 lines using 45 deg magnetic deflection. Tube has application in high resolution radar displays and in CE's thermographic scanning technique. Work spot size also would a conventional television picture could be compressed to an area measuring only 1/4 in. without loss of resolution, Schluenger said. Tube uses a four-fold, quadrupole super focused phosphor screen.

Electron beam tube with a high-speed, high current driver for matching computer data acquisition, using a matrix of back-biased P-N junction diodes which are irradiated individually by an electron beam, was described by Dr. A. V. Brown of International Research Machines Corp. Research Center. The diodes are conventional except that reaction is produced at a distance of only an micron below the surface. When electron beam strikes individual diode, it releases thousands of electron-hole pairs, giving an extremely short switching time of the order of 1 to 50 nanoseconds.

Field-effect cryogenic switch, now three thousand less temperature, stress sensitive than silicon Controlled, for use in high-speed computer circuits.



MINIATURE tracking wave tube for space communications. Type 6X5 tube, delivers 30 watts CW at frequencies of 1 to 22 kHz with gain of 40 db. Tube also in pulse mode, produced at Sperry Electronic Tube Division weighs 3 lb, measures 9 in. long.

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• Cooled infrared detector, consisting of a low-current Pelier cooler coupled to a photoconductive infrared sensitive detector, provides high detection in the 1 to 6 micron region. Three-stage Pelier (thermoelectric) cooler, requiring 75 amp at 2 v., reduces detector temperature to -78°C . A range of detectors are available and special shapes may be obtained. Manufacturer: Radiation Electronics Co., Division of Compensat Corp., 5008 Jena Ave., Chicago 46, Ill.



• Clatched synchro, an integral clutch, spring return mechanism and synchro all contained in Size 10 package. Return mechanism is set to ± 1 arm of electrical axis at the synchro and in gear synchro position to within ± 1 inch. The synchro can be rotated through 360 deg. Manufacturer: Aerodyne Inc., 121 Clinton Rd., Calicut N. J.

• Voltage-tunable magnetron, 1-pc. ZM 6619, provides a continuous of 10 w. cw power across its frequency range of 2.5 to 1.5 kmc. The tube can be electronically swept through its entire operating band in less than 1 microsecond. It is designed for use as a resonator that employs an electronically swept oscillator, test equipment, division line amplifiers and Shand output tubes. Its typical operating anode voltage may be 2,600 v. at 3 kmc. Average anode current varies from 10 to 20 ma, filament current is 3 amp., filament voltage is about 2.5 v. Testing rate is 1 v. per volt. Tube package requires only input connections and 300 power output connection, weighs 3.5 lb. Manufacturer: Power Tube Department, General Electric Co., Schenectady, N. Y.



AC

Beidman-Ivlar is a perfect "marriage"

Both firms have generated the development of electronic power sources. The recent association of Beidman Engineering Company, a leading manufacturer of a-c power supplies, and Ivlar Electronics Corp., a producer of quality solid-state d-c power sources, now provides superior capability in both a-c and d-c equipment. The Model 155A inverter is an example of a new line of flexible power supplies featuring separate plug-in oscillators in both fixed and variable frequencies from 45 to 500 cps. Other features are extended frequency capability, regulated short voltage amplitude stability and zero response time. The 155A is used in laboratory work and production testing and calibration of transformers, rectifiers, electronic meters and instruments.

A new line of fully transistorized d-c sources includes the TP Series of regulated power supplies for laboratory applications where a relatively wide range of voltage adjustment is necessary.

Modular units with exceptional stability over a wide temperature range, are now available in models up to 500 w. Modular construction provides wide flexibility in the design of digital computers, industrial controls and missile checkout and launching systems. Customers may also be achieved in laboratory use by operating modules in series or in parallel.



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What do our thermometers do? Trans-sonics, Inc. measures temperature. For example, they measure the skin temperature of a remote location, on and off-line types, as well as probes, may be used to locate: left hands, or only general support equipment — in many cases they form part of complete temperature systems designed and manufactured by Trans-sonics, Inc. And other manufacturers are adopting, studying, and of their long taking temperatures along the same horizon.

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To get the story in management

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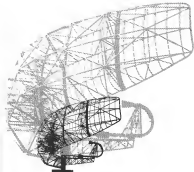
• Delay lines, designed for use with high-speed pulse meters, are available with time delays of 1 to 100 nanoseconds and are space packed and suitable for mounting on printed circuit boards. Race time for a 60 nanosecond unit is 9 nanoseconds. Ready for a 10 nanosecond unit is 100 ns. Model No. B-1 1/2, Inc., 195 Van Vorst St., Jersey City, N. J.



• Optical meter pump unit, Model 775, allows cooling rates of 2 sec. at 2,000 pulses and 3 sec. at 4,000 pulses for liquid gases. The pump is controlled by magnetic action. Both tubes with range as high as 20,000 pulses for pumping optical meter. Also electronic. Electro-Physics, Inc., 1 Radio St., Cambridge 48, Mass.



• Double beam, Model D-1342, a double beam radar for use in 1 to 100 to 4,000 sec range, employs E.T. conversion and laser locking cables. Known as good at 5775 cph and are available from stock. Manufacturer: Radar Design Corp., P.O. Box 101, New York, N. Y.



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SELENIA AIR TRAFFIC CONTROL RADAR OFFERS:

• LONG RANGE, HIGH ALTITUDE DETECTION OF EVEN THE DAMAGED TYPES OF AIRCRAFT THROUGH THE USE OF HIGH AVERAGE POWER AND A PARAMETRIC AMPLIFIER RECEIVER. THE MOST ADVANCED TRUE MTI SYSTEM IN THE WORLD WITH THREE PULSE CANCELLATION FOR CLUTTER FREE PRESENTATION AND STAGGERED DEFLECTION RATE FOR FLIND SPEED ELIMINATION. THE USE OF L-RANGE ASSURES SAFETY AGAINST OVERCROWDING AND LOW PRECIPITATION ATTENUATION WITH REASONABLY SIZED ANTENNA STRUCTURES. SPECIAL HIGH LIGHT ANTENNA FOR GREATLY IMPROVED SCATTERER VISIBILITY FOR CLOSE IN TARGETS AND CIRCULAR POLARIZATION FOR NEARLY COMPLETE CANCELLATION OF RETRAKE FROM PRECIPITATION. A RADAR COMPLETELY COMPATIBLE WITH IET AC EQUIPMENTS. A DIRECT SUCCESSOR OF THE FROTH BATHYSON AIRPORT AND AIRWAYS RADAR CHOSEN BY THE AIR TRAFFIC CONTROL AUTHORITIES IN CANADA, THE UNITED STATES AND SWITZERLAND.

Your company is needed for more specific information. SOME ITALY P.O. BOX 1983



Selenia in Britain in Europe



How common salt led
to an uncommon concept in communications.

An unusual new device to increase radio reflectivity, now under development at Northrop's Radioplus Division, may well revolutionize the field of space communications. Called ADSAT (for Anomalous Dispersion Spherical Array Target), it should extend the usefulness of passive communications satellites out to 32,000 miles—the 24 hour orbit.

The germ of the ADSAT idea actually came from early X-ray diffraction experiments with ordinary salt crystals which yielded a pattern of streaks bright and dark spots. This

hint of resonance with the crystal lattice led Northrop engineers to attempt to duplicate this effect at radio frequencies—and the first version of ADSAT looked much like a molecular model, with silver coated ping-pong balls serving as "atoms." The size of the balls and the intervals between them were carefully calculated to resonate with and reinforce the incoming frequencies.

In its present, basic form, the ADSAT satellite is a collapsible, spherical network, 160 to 600 feet across, with the resonant balls at

each intersection of the network. It is designed to be launched in a small package, and inflated in orbit, much like Echo. The reflected signal, however, can be 1,000 times as strong as that obtained from a simple, Echo-type target of equal size.

The development of the ADSAT concept demonstrates once again Northrop's unique ability to visualize problems in space technology, decide what should be done, and come up with solid, workable answers.

NORTHROP

BUSINESS FLYING



1982 MOONEY MARK 21C appears little changed from previous models, but features new propellers and hydraulic flap operation.

Mooney Plans New Models, More Dealers

Kennell, Tex.—Mooney Aircraft outlined large-scale step-by-step plans for expansion in the light aircraft field during unveiling of the 1982 Mark 21C at the company's dealer-distributor meeting here.

Mooney President (Mr.) Rachel outlined these steps to meet the goals set by Mooney management:

- Capital expansion is being under-taken to finance research and development on new airplanes, increased production of the current airplane and building of the sales organization.
- Three different airplanes are being planned now to add to the Mooney business aircraft model line within the next five years.
- Expansion of sales outlets will be speeded up to bring in more distribution and dealers at a faster rate than previously.

Although Rachel would not detail management's plans for capital expansion, he strongly indicated that main plans management was planning to bring

in additional partners—individuals who would contribute management skills as well as substantial money. He noted that today's low structure makes it exceedingly difficult for individuals or a small group of men, to rapidly accumulate enough money to move fast when opportunities present themselves and the necessary discipline was needed to

Mooney's present tightly held ownership.

Changes recently absorbed in subsidiaries, Mooney Aircraft Sales, to simplify its organization and prepare for financial expansion programs and also has started a program making employees to purchase shares.

Rachel emphasized that the com-

Mooney Mark 21C Price List

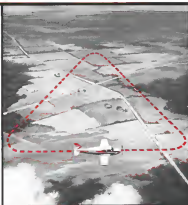
Standard airplane (flyaway prices, Kennell, Tex.)	\$16,450*
Package A (standard airplane with Mooney full equipment)	\$17,100
Plus Mooney VHF 1 Superomni	\$42,775
Plus Mooney VFR 2A Dwyer	\$15,279
Plus Mooney M-215 160/950 channel plus com	\$19,980
Plus Mooney Mark X and seats	\$19,980
Plus Mooney M-215 160/950 channel and seats	\$19,980
Plus Mooney M-215 160/950 channel and seats	\$19,980
Plus Mooney M-215 160/950 channel and seats	\$19,980

* Price of 1982 standard airplane was \$16,450.
† For delivery beginning January 1982.

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If you're ever lost, here's what to do: **WITH RADIO CONTACT:** Time to emergency frequency 121.5 mc. Fly a triangular pattern to the right in 2 minute legs with 3½" per second turns at 120°. Complete a maximum of two patterns before resuming course. If radio contact is established, instructions will be given on 121.5 mc. **NO RADIO CONTACT:** Fly a triangular pattern to the left on the manner described above. If radio contact is established, a Search & Rescue plane will be dispatched for interception. Description of course will not compress this system as your plane will continue to be tracked as "distressed" from the point of initial radio contact. If possible, repeat the procedure each 30 minutes until instructions are received or interception by Air Rescue Service is accomplished.



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tain that one of the three engines will continue to be constantly inflating versions of its present Mark 21—outspace competitors because an additional 13 years life for this basic engine.

Although details are not forthcoming as to the other two engines, Aviation Week learned that the company's current market philosophy is to keep its product line in the under 6,000 lb weight class at least over the next five years. Since one of the new products apparently will be a light twin, this would place it in the same death as the Beech Bonanza, Cessna 210 or Piper Comanche 250. In both enterprises, Vice President Chief Engineer Ralph Hansen is shooting for design breakthroughs that will provide major performance and weight gains in these competitive breeds while not engaging in a horsepower race. Engines could be in competition on aerodynamics and new maintenance techniques, rather than making performance gains using brute force of larger powerplants.

Indications are that work is well under way on the drawing boards on the next airplane to join the basic Mark 21 and that chances are good that it will be available in the next 18 months.

Mark 21 Changes

In the interim the basic Mark 21 provides the base for future growth development. The 1952 Cessna four-place airplane extremely varies little from the previous airplane, which endorsement is not new, but yet while retaining the basic design (AW Jan 16, 1951, p. 195).

Externally, changes are few. The McCulloch propeller being replaced in 1952 is. Historically, new model HC CYR/7550. The 74 is a constant speed, one variable-pitch model. The engine cooling and flap have been made longer than last year to provide improved cooling. These flaps open a minimum of three degrees, which is less than last year's model and are said to give improved cooling with less drag. Engine cooling also can be on access panel on the left upper rail for the left fan.

Major improvement over the 1951 model is an increase in wing flap deflection—Cessna airplane flaps can be depressed 55 deg. compared with previous maximum deflection of 25 deg., providing better landing control and handling characteristics. Increased deflection was made possible by replacing the former mechanical system which was unable to cope, result with the forces that are readily after using the 25 deg. deflection with a hydraulic system that is



HONEY FORSEES another 10 years of life for the present Mark 21 basic design.



MARK 21 INSTRUMENT PANEL has Gervin gauges grouped by function.

tapped off the airplane's wheel landing system. Flaps are now lowered by pressing the flap release button located under the throttle and raising the flap handle; each flap movement lowering the flaps approximately seven degrees, and raising approximately five and a half inches at the handle to allow full deflection. Actuation is accomplished by pulling the flap release control out and. A synthetic rope in the handle is which prevents sudden flap release, with possible adverse effects.

Redder Travel Increased

Redder travel is also increased five degrees in a total of 25 deg., providing improved control, particularly under crowded conditions.

Slip gauges on the clevises and cables have been decreased and the clevises balance weights reduced to allow a weight saving of some 40 lb. Redder Travel pointed out: The airplane's weight is now up some 55 lb.

as last year's airplane and gross weight is up 125 lb. Weight on wings now present carrying four passengers and 55-80 lb of baggage, full fuel and normal radio equipment meet the legal limit.

Interior Revision

Although it has been proved completely practical, the instrument panel which now utilizes a full complement of Gervin gauges is standard. Hansen pointed the Kober out as a model of Missouri's going to a business concept in drawing various areas of the airplane. In designing new instruments, in this case Gervin, the firm responsible is built that a superior design with greater reduction in fuel and heavier needs current status of trying to arrange a panel without varied and individual equipment.

Engine gauges, for example, provide fuel capacity, reading in pounds rather than gallons, oil temperature, oil pressure, cylinder temperature, and another



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is one danger. The manifold pressure is combined with the fuel pressure, gage and the tachometer is located directly above the manifold pressure gage, far from reading. Vacuum pressure indicator has been deleted—replaced a master gage, warns owner of "high" and "low" lights in need—the "high" light indicating a regulator stuck on the high side, above the vacuum required for proper gase operation and the "low" light indicating that there is vacuum pump failure.

Cabin Trim

New cabin interior trim represents another departure by the company, whereby it is reducing its upholstery operations and buying nylon material directly attached to sound absorbent backing panels from an automotive supplier, Superior Trim Co., Findlay, Ohio, which are simply swapped into place. Memory claims the new interior is superior to its previous method and that the interior is lower in cost.

Engine exhaust system was turned over to Harsco-Walton for specialized design and the result is a unique dual Harison design is better tuned to the engine's exhaust impulses, with reduction in back pressures and improvement in noise characteristics. The new exhaust system has successfully improved the best jet system so that 50% more cabin heat is available while maintaining best characteristics are also markedly improved.

Gages and gauges controls were also designed on a cabinet basis by I&M Controls, Tulsa, Okla.

Mooney Mark 21C

Maximum gross weight	2,575 lb.
Empty weight	1,321 lb.
Useful load	1,256 lb.
Maximum baggage capacity	220 lb.
Pilot capacity	40 gal.
Maximum cruise speed (75% power)	at 7,500 ft. 150 mph*
Optimum cruise speed (50% power)	at 5,500 ft. 172 mph*
Maximum cruise speed (50% power)	at 10,000 ft. 164 mph*
Stall speed (power off, gear and flaps down)	47 mph
Stall speed (power on, gear and flaps down)	54 mph
Best climb rate (power off)	181 mph
Best climb rate (power on)	120 mph
Normal speed, no reserve (5,000 ft.)	141 mph
Maximum range (12,000 ft.)	3,130 mi.
Powerplant	1 Lycoming O-360 A 100 at 183 hp, at 2,700 rpm

* True speeds, based on gross weight and standard equipment.

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Dr. A. L. Davis, Vice President, is quoted as saying: "I don't know how to do it, but I will do it."

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[illegible]

Note: January through July 2011 pigweed is labeled 4.00 month having a total net long value of \$10,000,000. It compares to 4.62 months above during a brief and falling season of 200,000,000 in the same period last year. July's net value above a gain of three months over the same month last year. See <http://www.fishbase.org> for more fish.

Hopson says the HA 750 will be delivered with a full range of instruments, including auto pilot, weather radar, ILS, VOR and a VHF or UHF transceiver.

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Skymaster panel in order ready-up was described by Gress as production configuration. Engine and propeller controls are grouped, not about the effort, below the radio, which is mounted in the center of the panel. Throttle, left, and propeller controls, center, are designed for mechanical operation and are designed to prevent inadvertent interference. Flight instruments are directly in front of the pilot, at left. Engine gauges are at right. Fuel gauges in rectangular panel, upper right indicate 15 gal. for each auxiliary tank and 50 gal. for each main tank. Wing flap indicator (shows four positions, 25, 35, 50 and 60 deg.) Mainfield pressure, engine rpm, and fuel pressure gauges to right of radio, combine reading for both engines on one bar for each indication.

Skymaster Panel, Engine Configurations Revealed



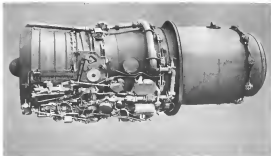
An inlet for Skymaster's turbocharged engine, 545, from the front, shows shoulder intake wing at bottom. Polar-mounted Continental KD300-A engine is left by two in width, one on each side of the fuselage, just under the trailing edge of the high wing. Powerplants (the inner) are mechanically unrelated horizontally opposed types and develop 215 hp at 2,500 rpm on takeoff and 215 hp at 2,400 rpm at 2,100 ft., using 98/130 octane fuel. Direct-drive pusher propellers require 295 hp each and are water-cooled.

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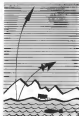
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FINANCIAL

Lockheed Earnings May Top \$25 Million

By Joan D. Hendricks

New York—Defense and aerospace program diversification has given Lockheed Aircraft Corp. a good balance in smoothing out its profits in those areas and should help give the way toward increasing sales and earnings, according to Board Chairman Clarence S. Goss.

Goss, elevated from president to chairman in September following the death of his brother, Robert, the former chairman, (AVN Sept. 21, p. 10) told the New York Society of Security Analysts that Lockheed earnings may reach more than \$25 million this year.

He added that profits should be "considerably better" in 1962, with sales rising from a projected \$1.4 billion for 1961 to about \$1.5 billion next year.

"We have avoided a sort of diversification plateau," Goss told the analysts. "We shall pursue diversification more with increasing loss a sense of urgency, and we shall apply a high degree of discrimination and judgment in evaluating new opportunities."

The Lockheed chairman cited estimates of non-aerospace business as one of the firm's long-range diversification goals. He gave the following percentage breakdown for Lockheed's business this year:

Military, 27%; space projects, 26%; aircraft and related systems to the U. S. government, 20%; aircraft and services to foreign governments, 16%; commercial aircraft spares and services, 6%; and 5% in shipbuilding, electronic and products, procedures and other fields.

Goss said some of the recent Lockheed operations "have had quite a struggle" adding that the company had partially experienced these problems. He discussed the status of three recent additions to Lockheed:

• **Proprietary Bridge & Drydock, South-West**—a "possible, but not as probable as we would like," Goss said. He noted, however, that the firm "is doing well with a good backlog and a much higher business and employment level than when we acquired it."

He had a good and experienced management group there, he said, pleased with them, and he said he couldn't see why they had business going well.

• **Lockheed Electronics Co. of Flushing, N. J.**—he said is the real and likely to remain as his own company, he said. Goss reported: "We are building up a fine production business in Boston, printed circuit boards and some other

areas, but we are investing and spending for additional aircraft and product development in goals for more rapid growth."

• **Lockheed Propulsion Co. of Redlands, Calif.**, formerly General Electric Rocket Co., also is in the expandable column, Goss noted. "Now that we have secured complete ownership (AVN Nov. 5 p. 36), we are trying to streamline its operations, and we are working it with plans to replace a larger share of the growing solid fuel business."

Pursuing the company's third quarter report to the analysts, Goss based his predictions for a possible \$25 million in profit in earnings this year on an expected continuation through the

fourth quarter of the company's upward trend of account during the first nine months of 1961.

Third quarter earnings were \$7,779,000 or 96 cents per share resulting from sales of \$316,379,000. This compared with third quarter 1960 earnings of \$5,468,800 or 74 cents a share on sales of \$305,221,000.

Nine months net profit this year was \$16,102,800 or \$2.10 per share based on sales of \$997,442,000 compared with a net loss of \$980,400 or a loss of \$0.90 per share on sales of \$964,705,000 through the same period in 1960. Earnings on Sept. 24 this year was \$4,703,844,000 compared with \$1,367,178,800 on the same date in 1960.



Blue Scout on Mercury Mission Is Destroyed

The Blue Scout vehicle, shown with payload (shown removed during checkout at the Atlantic Missile Range) was destroyed 30 sec. after liftoff, Nov. 1, when it deviated from its trajectory. The payload, a 100-lb communications satellite package, was to have tested the Project Mercury tracking network during orbital passes. Blue Scout is gas-actuated and controlled by jet nozzles during the boost phase.



ENGINEERS ARE CHARTING A NEW COURSE AT AC

AC's current assignment is Systems Integration for the modified B-6000 Guided Missile System. AC's responsibility includes program and engineering design, test and as a director of missile operations in the production phase. Other projects at AC include a new manufactured control guidance system for the TITAN missile in addition to AC's Los Angeles Advanced Development Laboratory is currently developing Advanced Missile Guidance Systems. AC is seeking qualified men to work on these important projects. If you have a BS, MS or PhD in Electrical Engineering, Mechanical Engineering or Physics, please contact Mr. G. F. Kneass, Director of Research and Professional Employment Dept. 3020 1035 South Horley, Milwaukee 5, Wisconsin. An Equal Opportunity Employer. Interviews pending availability.

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Lockheed reported a low of \$1,000,000 at the end of last year to about \$2,121,139,000.

Cross verified that the 1956 law was revised attributable to large increases in the Electro Aerospace transport and missile systems jet engine transport programs. He said Lockheed has partly not taken off both vehicles.

The Electro problem, we feel, is very isolated in," Cross observed. "There still remain the model Electro (the result of a canceled order last year by Capitol Aerospace) but we believe we can sell these."

Titan sales have gone slower than hoped, Cross admitted, and the company has recorded an additional order of about \$1.5 million for the third quarter to the fourth end, however, that Federal Aviation Agency certification of the plane and its engines in the civilian aviation should result in as many as commercial orders.

"We are very much interested in the supersonic transport," Cross added. "For the first time since World War II Lockheed is not in production on a commercial transport. But this is an area of high competition in our company, and we by no means intend to work ourselves out of the commercial aircraft market. We have already done much research in the supersonic field, and we will compete when the time for competition comes."

Foreign production of Lockheed's P-104 Starfighter often the company profit particularly as become and mostly from and present the technical success, the Lockheed division noted. Although production in the foreign contract is on the order of one fourth is profitable as if we built the airplane ourselves," Cross said, the program is beneficial to Lockheed and the U.S. aircraft industry and international relations.

The Starfighter missile production program will contribute about \$1 billion towards solution of the balance of payments problem, Cross added, with that amount doubled along with, thus 500 subcontractors, suppliers, vendors and other firms in the country.

6 Aerospace Firms Report on Earnings

Six aerospace companies released financial reports to stockholders recently and one of the firms, Republic Aviation Corp. of Farmingdale, N. Y., announced a projected loss for one consecutive third year.

Republic's director held a meeting for Dec. 15 of stockholders on record Nov. 15 to vote on the proposed split of the company's current 2,500,000 common shares. If the split is approved, it probably will become effective by the



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PROBLEMATICAL RECREATIONS 92



Show that $\frac{1}{10}$ is a root of the equation $2x^3 - 10x^2 + x = 0$.

—Contributor

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ANSWER TO LAST WEEK'S PROBLEM: Let T = (initial position of the remote hand, in minutes after the hour). The initial position of the hand head is therefore $(20 - \frac{T}{10})$. The hand head travels a distance $T - (20 - \frac{T}{10})$, which is $1/10$ of the distance which the remote hand travels, so $-(T - (20 - \frac{T}{10})) = \frac{1}{10}(T - (20 - \frac{T}{10}))$.

Solving, $T = \frac{200}{11}$ minutes and the time is 10:54 5/11, or 26 8333 minutes after 4:00.

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end of the year mark the shares, were valued at \$4 per share, adjusted to 50 cents.

A quarterly dividend of 15 cents per share would be established on the new stock, compared with 30 cents now in effect.

Non-interest net earnings for 1960 were \$7,932,062 or \$5.21 per share on sales of \$276,755,908 compared with \$1,872,544 or \$1.16 per share on sales of \$135,264,645 for the same period last year.

Current backlog was reported at \$609 million.

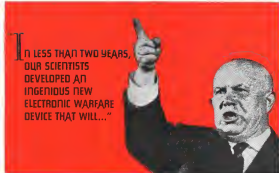
•McDonald Aircraft Corp. of St. Louis, Mo., showed net earnings of \$2,846,626 at 77 cents per share (\$4.75, 712 shares outstanding) on sales of \$79,668,373 for the third quarter of 1960. Earnings were up 41% over the \$2,140,730 or 74 cents per share (\$3,422-757 shares outstanding) for the comparable period last year, when sales were \$69,114,685. Sept. 30, 1961 backlog was \$390,351,116 compared with \$163,722,734 on Sept. 30, 1960.

•Northrop Corp. of Beverly Hills, Calif., reported net income of \$8,671,521 on sales of \$367,456,965 during the fiscal year ended Feb. 21, 1961, compared with earnings of \$7,920,218 on sales of \$219,679,427 for the previous year. Net earnings per share were \$4.22 on 2,052,848 outstanding shares, the same as in fiscal 1960 on 1,815,156 shares.

•Rolls-Royce Corp. of Chula Vista, Calif., reported record high earnings of \$1,573,676 or \$2.74 per share for the year ended July 31, although sales declined from \$191,249,182 last year to \$163,170,217 this year. Fiscal 1960 loss was \$2,604,575 or \$1.33 per share. Bookings were reported at \$126,519,910 on July 31, 1961, compared with \$138,586,000 at the same time last year, but company officials and orders received July 31 has increased the current backlog to \$139,340,600.

•Sundstrand Associates, Inc., Madison N. H., reported that sales for the fiscal year are expected to reach \$40 million compared with \$21.1 million last year.

•Aviation Associates, Inc., of Los Angeles reported a 10% to profit during the week-end period ended Aug. 31 with \$28,900 net income, equal to 10 cents per share on sales of \$5,913,000. This compared with earnings of \$1,211,655 or 31 cents per share on sales of \$4,977,514 for the same period in 1960. The situation's various manufacturing and maintenance a net loss of \$257,629 on sales of \$9,243,376 for the fiscal year ended last Feb. 25. Board Chairman Robert L. Reed and President Refill M. Russell noted that during the six months through August, the company's net working capital rose \$735,690 to \$411,000.



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The manufacturer claims the entire unit can be adapted for use as a general coefficient, electric and diagnostic instrument for systems, deployed and land based equipment.

Industrial Acoustics Co., Inc., 541 Jackson Ave., New York 34, N.Y.



Instrument Test Unit

Aerospace Mechanisms Vacuum Instrument Test Unit is used to perform accurate checks on the ground of high pressure, medium and low pressure gas and pneumatic instruments without need for the standard test equipment.

Unit accurately holds constant vacuum levels from 0.1 to 100 in. Hg. A single control knob permits rapid ad-

justment to any required vacuum in the range. The unit basically consists of a diaphragm pump connected to an adjustable, diaphragm-type vacuum regulator valve. Constant speed, 5 hp., 115 v. electric motor drives the pump at a pre-determined speed comparable to actual engine operation.

Unit is portable and self-contained, weighing 40 lb. It is contained in a sand-filled metal case with carrying handle. Dimensions: 16 in. long, 12 in. wide, 18 in. high. Pump exhausts through a muffler.

Aerospace Mechanisms, 13329 Shaw Ave., East Cleveland 12, Ohio

Hydraulic Boom Lift

Crown Industries, Inc., Sky Platform has been used in the Air Force for some time. It can be used in aircraft maintenance and loading operations and is now in the commercial market.

The hydraulic lift can easily elevate two men in a fully constructed and loaded basket as high as 100 ft. and rotate the basket in either direction up to 160 deg. Turns lower than the basket from the track chassis, which is secured in a fixed position by outriggers.

Dual control levers are provided at the ground control panel and in the basket with an outside feature in the ground controls. Separate levers rise at lower the upper and lower basket, and a third lever controls rotation.

The equipment is being sold through local distributors.

Crown Industries, Inc., Galesburg, Ohio

Refrigeration Service Manifold

New Model 2484 manifold connects into refrigeration or conditioning systems and is used to cut non-flammable gases from these systems in such as 25% an action and constant an action.

The portable manifold is subdivided for the recovery or use in the refrigeration system and is designed for venting in the same location as the recovery or use.

By controlling inlet test controls the manifold allows the manifold substantially reduce the inlet and a substantial safety factor. Connections between operations are maintained to reduce danger of vacuum contamination, and the manifold provides an integral descent and lift for the test equipment. Relief valve prevents over-pressurization of the manifold during leak tests. Manifold was designed for DC-8, but is used to be adaptable to other aircraft.

Barlow Industries, Inc., Barlow Manufacturing Co., Northridge, Calif.



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We invite you to contact Mr. W.D. Hobbs

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UNITED AIRCRAFT CORPORATION**

440 Main Street, Westborough, Mass.

All qualified individuals will receive consideration for interview. Salary subject to background check and references.

WHO'S WHERE

(Continued from page 27)

Changes

Stanley E. Kaufman, director of design work planning, Technical Operations Inc., sub-office in Washington, D.C. William P. Mueller, Jr., assistant vice president, is director of the company's Washington Research Office, Washington, D.C.

D. C. Arnold, chief engineer, Radio Corporation of America, Aerospace Communications and Controls Division, Defense Electronics Products, Chino, N.J.

F. T. Hadden, construction director, Army Engineer Division of Ball's Bluff, La. Derby, England. Mr. Hadden continues in his assignment as director of the International Division.

Dr. Ralph F. Hadden, chief, Electronics Division, National Bureau of Standards, U.S. Department of Commerce, Washington, D.C.

Allen C. Waggoner, executive assistant to the director of research and design engineering, AEC, Division of Civilian Engineering, East York, N.C.

Howard E. Hays, engineering manager, Electronic Division, The Ralph M. Parsons Co., Pasadena, Calif.

Joseph E. Kern, general sales manager, Lockheed Corp., Coalinga, Calif.

George Nadeau, assistant general manager, Kuhlert-McIntire Division of General Processes, Inc., Van Nuys, Calif.

Thomas A. Therp, manager of General Engineering & Research Co.'s Washington, D.C. office, including AEC-D-58, retired.

Douglas L. Givens, assistant Boeing Manager, Los Angeles Area Space Division, The Boeing Co., Cape Canaveral, Fla.

Dr. Chien Hsueh, research manager, Cassin Corp., Corbin, Ohio.

Frank K. Olsky, chief engineer, Research Inc., Santa Monica, Calif.

Gerard L. Nais, instrumentation engineering manager, Fairchild Instruments Division, Van Nuys, Calif. a division of Fairchild Camera and Instrument Corp.

Steven M. Sorenson, head, Communications Team, Thomson Laboratories Applied Research Division, Watertown, Mass.

Harold Peles, personnel relations manager, as of the Washington, D.C. office, Lockheed Research Co. division of Sperry Rand Corp.

Dr. Frederick Labovitzky has reported that Dr. David D. Ely, Los Angeles, U.S. Office of Naval Research, physicist, head the plasma propulsion section leading to the U.S. Navy and Westinghouse as principal.

R. A. Eves, assistant manager of the Boulder-Cole division of Ball's Bluff, Calif. Corp.

Dr. James M. Meeks, director of research, Research and Development Center, Smith Research, Ball's Bluff, California.

Dr. Robert S. Calman, assistant director, research and development, Aeroflex, a division of North American Aviation Inc., Downey, Calif. and I. N. Schmidt, chief, spacecraft engineering.

E. M. Smith, manager of manufacturing, Los Angeles Division, Los Angeles, Calif.

Systems Technology at

AEROSPACE CORPORATION

The scientists and engineers of Aerospace Corporation are concerned with space and missile systems development in unity—at every stage from concept to system testing. They use systems techniques and systems engineers in the broadest sense—interdisciplinary problem-solving—qualified to apply unusual creative insight and ability from the broadest administrative levels.

As the nation looks toward the Air Force—military-related from responsible for development of advanced ballistic missile and space systems, they are also going with applying the nation's full scientific and technical resources toward meeting system concepts and objectives in an economical and timely manner.

Within the Systems Research and Planning Division of Aerospace Corporation, these men are concerned with the formulation and initial development of advanced systems concepts to meet future Air Force needs in space. Their duties are on the order of two to 15 years and project magnitude extends to billion dollar programs. Activities include: concept generation and evaluation, preliminary design, development program formulation, preparation of preliminary design specifications in the form of requests for proposals, technical evaluation of military proposals, direction of industry study and research programs, system analysis, conduct of critical experiments, statistical analysis, studies and identification of needed areas of research.

Once industry development contracts are awarded, the men of Aerospace Corporation's Engineering Division guide the conversion of system concepts into actual operating hardware. In providing technical direction and supervision for the Air Force, they look to include not only system integration including design coordination between subsystems, recommendations on subsystem trade-offs and improvement of system design—all in reference to meet system concepts and actual capabilities. Their efforts are directed toward such areas as: vehicle analysis, defense systems, space launching systems, early warning, missile, radio-relay and communications satellites, and systems for developing recovery, rendezvous and anti-space capabilities.

Today, continuous growth in Aerospace Corporation's responsibilities strains the capacity for expansion of the Corporation's industrial staff. The need for engineers and scientists who have individual capabilities in their field and new desire to exercise their full interdisciplinary capability. Requirements include an advanced degree and extensive experience.

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CONTROLS AND HYDRAULICS. Design and analysis of aircraft control system and/or analysis and installation of hydraulic controls.

ELECTRICAL. Aircraft AC and DC power generating and distribution systems design.

ROTOR. Aircraft mechanical design experience with highly loaded rotating mechanisms and forgings.

RELIABILITY. Establish reliability programs for various projects consistent with customer and company requirements.

EQUIPMENT. Design and installation of heating and ventilating systems, aircrew accommodations, cabin interiors and auxiliary systems.

DYNAMICS. Experience in the analytical analysis for advanced design studies on helicopters and VTOL aircraft.

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OTHER BOEING DIVISIONS. Aerospace, Industrial Products, Seattle, Washington; Transport, Renton, Washington; Wichita, Kansas.



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Work will involve machine studies using modern computer techniques. Requires 3-5 years experience.

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This work involves design and development of solid state power conversion equipment. Experience is needed in the operation of silicon controlled rectifiers in powerhandling circuits. Requires BSEE and 3-5 years experience.

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Program management positions including responsibility for direction of all phases of business for assigned accounts. Entails proposal preparation, contract negotiation, and post-award program administration. Position requires close liaison with all levels of management, both with customers and internally, to insure contract fulfillment. Practical experience in decision making in all areas of business management, including program planning and budgeting, program monitoring from initiation to completion, customer negotiation and liaison and proposal preparation. A college degree and strong business management orientation preferred, including experience in administration of government contracts.

Send resume to Mr. John Cohen, Employment Manager, Honeywell Corp., 1410 Stevens Blvd., Minneapolis 15, Minnesota

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To explore professional opportunities in other divisions of Honeywell, send us 10 cents' worth of your application card, or write to Mr. D. G. Davidson, Honeywell, Minneapolis 15, Minnesota

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